

**STREAMS OF WESTERN PLACER COUNTY:
AQUATIC HABITAT AND BIOLOGICAL RESOURCES
LITERATURE REVIEW**

**Prepared for:
SIERRA BUSINESS COUNCIL**

**Prepared by:
Randy Bailey
Bailey Environmental
3050 Meadow Creek Road
Lincoln, CA**

December 2003

INTRODUCTION

The purpose of this report is to provide a summary of the pertinent literature (subject to time limitations; an assessment of the quality and quantity of data available for several important types of parameters (e.g., water temperature, habitat quality; water quality, etc.); and an overall assessment of the general condition of the stream to support anadromous salmonids, adequacy of the data to support specific decisions regarding the stream's potential to support anadromous, and a list of factors that should be considered in the Habitat Conservation Planning process.

This literature review and assessment is focused on the following general areas that are important to understanding the current condition of the stream and assessing its potential as an anadromous fish stream:

- Existing Water Quality Data
- Water Temperature Data
- Benthic Macroinvertebrate Data
- Physical Habitat Data
- Fishery Resource Data
- Fish Passage or Screening Data

METHODS

The data and information used to prepare the data summaries and overall assessment of stream conditions are from a variety of sources. Limitations on the time available to conduct the literature review precluded an exhaustive search of all possible data sources. I have concentrated on reviewing California Department of Fish and Game files, data and sampling efforts conducted by the various watershed groups, and environmental documents prepared by the various jurisdictions that include information about this watershed.

Where the amount of data from a particular source was small, I incorporated all of the relevant information completely in this report. In cases where the volume of data was large, I summarized the data into what I considered meaningful units. This is particularly true for the water temperature data. Where data is presented, the source has been documented within the presentation. This allows the reader to immediately understand where the data or information originated. In addition to the data and information presented, I also reviewed the VHS tape of the stream videography project to provide additional visual assessment of the watershed for the areas flown.

Although the data were to be submitted in an Excel spreadsheet format to the Sierra Business Council and County of Placer, my review has found very little information that is in electronic format. Also, much of the data is scattered in various files with just snippets of information in a single location. Where possible, I have included electronic copies of the data to the County under separate cover. This is particularly true of the water temperature data from the continuous monitoring sites (this data has already been

transmitted to the County). Some other data sources may be electronic format, but may not be transmitted to the County because of the limited nature and overall usefulness, unless the County decides otherwise (e.g., water quality and benthic macroinvertebrate data).

Water Temperature

Since daily maximum, minimum, and/or mean temperatures individually are of little value, I have chosen to plot all data points. Therefore, I have split the year into time periods that roughly correspond to:

Fall-early winter: September through December: primary fall chinook spawning period is November-December.

Winter-spring: January through April: fall chinook incubation and rearing and steelhead spawning, incubation, and rearing.

Late spring-summer: May to September: summer rearing for steelhead juveniles.

Data plots for these time periods are presented below to allow the reader to assess the potential of Dry Creek to support chinook salmon and/or steelhead trout spawning and rearing. A variety of localized data and literature was reviewed, in order to get some generalized understanding of the temperature effects on various life history stages for both chinook salmon and steelhead trout. There is fairly substantial variation in temperature effects noted for most life history stages. However, the reader is reminded that both chinook and steelhead have a highly adaptable physiology and ability to seek thermal refuge during part of the day which allows them to tolerate and/or avoid lethal temperatures. Some of the literature sources cite criteria from others and some of the data is based on fish captures with water temperature taken concurrently. Two tables with data and reference are included in Appendix A of this report. Based on this review, the following criteria have been used to indicate what life history stages a particular stream may support at any given time:

<u>Chinook Salmon</u>	<u>°C</u>	<u>Steelhead Trout</u>	<u>°C</u>
Egg and fry development	14.4 (58 °F)	Egg and fry development	14.4 (58 °F)
Juvenile rearing	21.1 (70 °F)	Juvenile rearing	22.2 (72 °F)
Adult migration	21.7 (71 °F)	Adult migration and holding	22.2 (72 °F)

To aid the reader, I have placed reference lines, as appropriate, on the graphics at 14.4 °C and at 22.2 °C to roughly represent the water temperatures suitable for salmonid spawning migration, egg and fry development, and juvenile rearing.

AUBURN RAVINE

A. Water Quality Data

1. **Lincoln High School Water Quality Monitoring:** Mark Fowler and Lee Beckman provided data from the Lincoln High School sampling program, which is jointly funded by NID, Placer County, and the City of Lincoln. While the data are limited, two parameters are of concern from a stream ecology standpoint. First, the dissolved oxygen concentrations reported show supersaturated levels of approximately 150%, which is unusual for lower gradient streams. Second, the concentrations of nitrate reported for Highway 193 and Joiner Parkway sites are high for a fall reading and could indicate eutrophication of the stream, particularly during the summer months. Without data on orthophosphate for comparison, it is not possible to determine if nitrates are limiting biostimulation of algal growth and potentially causing diurnal dissolved oxygen fluctuations during the nighttime hours. **Source: Lincoln High School Sampling Program, unpublished data.**

Table 1. Auburn Ravine Water Quality Data 2001-2

Parameter	Mackenroth Property	Highway 193 Bridge	Joiner Parkway Bridge
Date	9/21/2002	10/7/2002	9/23/2001
Time	1000	1128	1045
Air Temperature (°F)	67	--	--
Water Temperature (°F)	60	65	62
Weather	Clear	Clear	Clear
Stream Flow (cfs)	7.7	1.5	1.5
pH	7.7	7.7	7.16
Dissolved Oxygen (mg/l)	13.4	13.4	16.5
Electrical Conductivity (µs/cm)	152.9	56.4	71.7
Color (color units)	42	1	8.5
Nitrates (mg/l)	0.7	1.1	1.90
Chlorides (mg/l)	0.04	0.07	0.02
Total Coliform (MPN/100ml)	240	290	290
Fecal Coliform (MPN/100ml)	460	93	75

2. **Auburn Ravine/Coon Creek Ecosystem Restoration Plan:** This plan, published by the County of Placer, contains preliminary data on heavy metals and a number of other constituents. The data were collected on Auburn Ravine, Coon Creek, and in the Eastside Canal (the actual sampling location is actually just upstream of the Cross Canal, even though the data location is labeled Cross Canal). The County is already in possession of these data in electronic format and the data are not re-presented, except for data on cadmium, copper, and zinc, which are presented in Appendix Auburn Ravine 1 because all of these metals at some times of the year exceed California Toxic Rule objectives for aquatic life. In Auburn Ravine, the only metal that exceeds the standards at 50 mg/l hardness is copper. The other metals are included because their standards are exceeded in other streams in the western portion of the County. Based on these

data, the ratio between orthophosphate and a combination of dissolved nitrite and nitrate appears to be reasonable and should not cause excessive algal blooms at this downstream location.

Source: California Toxics Rule and Department of Water Resources unpublished data.

3. 1992 City of Auburn Wastewater Treatment and Disposal Master Plan DEIR:

Table 3-2 in DEIR displays summary data from three stations. These stations are Clark Ranch at Bridge Lane (upstream of Fowler Road), Brewer Road crossing, and Catlett Road crossing in Sutter County. Four or five samples (Bridge Lane only) were taken during August-September of 1987, with no specific dates given. Table 2 displays the pertinent average summary data. In general, the water quality parameters measured fall within an expected and acceptable range for anadromous fish streams. Appendix E in the DEIR includes a complete set of data for the U.S. EPA priority pollutant scan required for NPDES permit renewal. Review of this data did not indicate any problems with pesticide concentrations, and the heavy metals analysis shows no readings that exceed California Toxic Rule standards. **Source: 1992 City of Auburn Wastewater Treatment and Disposal Master Plan DEIR; R.E. Beck. 1987. "A Preliminary Report on Fishery Viability of Auburn Ravine Creek, Placer County, California", from Department of Fish and Game files, Region 2.**

Table 2. Mean values of selected water quality constituents from three locations along Auburn Ravine from samples collected during Aug.-Sep. 1987.

Constituent	Clark Ranch Bridge Lane	Brewer Road Crossing	Catlett Road Crossing
Number of samples	5	4	4
Turbidity	None	V. Slight	Milky
Temperature	64	67	68
pH	7.0	7.3	7.3
Ammonia Nitrogen	0.6 mg/l	0.4 mg/l	0.8 mg/l
Dissolved Oxygen	10 mg/l	10 mg/l	6 mg/l
Carbon Dioxide	5 mg/l	5 mg/l	26 mg/l
Total Acidity	9 mg/l	10 mg/l	36 mg/l
Total Alkalinity	23 mg/l	65 mg/l	150 mg/l
Hardness	34 mg/l	77 mg/l	155 mg/l

Source: 1992 City of Auburn Wastewater Treatment and Disposal Master Plan DEIR; R.E. Beck. 1987. "A Preliminary Report on Fishery Viability of Auburn Ravine Creek, Placer County, California", from Department of Fish and Game files, Region 2.

4. 1997 City of Auburn FEIR Auburn Wastewater Facility Plan: This FEIR contains data on a variety of water quality parameters measured on Auburn Ravine sources. These measurements include a U.S. EPA priority pollutant scan for pesticides and heavy metals. Data on heavy metals concentrations are presented in Table 3-10 of the FEIR. These data show no metals at concentrations of concern for the protection of aquatic life in Auburn Ravine upstream of the discharge. No data is presented for areas immediately downstream of the discharge location. Table 3-11 in the FEIR also shows some water quality data for six stations downstream of Lincoln (Table 3-11 in the FEIR indicates that station L7 is upstream of the City of Lincoln, but Figure 1 in Appendix E of the FEIR shows station L7 downstream of the City. The data in Table 3-11 do show one area of concern, the range of pH values over the sampling period at the

“lower reach” of 5.95-7.4. The low value of 5.95 is of concern because of its potential effects on aquatic life. Also of concern is the range of values recorded over a relatively short “summer” time period. Appendix Auburn Ravine 2 of this report is adapted from Table 3-9 in the FEIR and displays sampling results during 1995 at two locations, one upstream of the discharge location (R-1) and one immediately downstream of the discharge in the mixing zone (R-4). These data show pH values fluctuating from 5.7 to 7.4 over the course of two months. This pattern is consistent with that observed in other nearby watersheds. Appendix B of this report also shows that water temperatures and dissolved oxygen levels are suitable for spawning and rearing of anadromous fish species on a year around basis. **Source: 1997 City of Auburn FEIR Auburn Wastewater Facility Plan.**

5. 1996 City of Auburn, Draft Auburn Wastewater Treatment Plant Stream Study: At public request, this study was conducted to assess the impacts of treatment plant expansion on the aquatic ecosystem of Auburn Ravine. This report contains much more detail on the water quality information summarized in the 1997 City of Auburn FEIR Auburn Wastewater Facility Plan mentioned directly above. **Source: 1996 City of Auburn, Draft Auburn Wastewater Treatment Plant Stream Study.**

6. 1999 DEIR City of Lincoln Wastewater Treatment and Reclamation Facility: This DEIR was prepared to support a new wastewater treatment and reclamation facility to meet growing demand within the City of Lincoln and possibly serve as a future site for a regional wastewater treatment facility which could receive effluent from Placer County’s SMD #1 Plant on Joeger Road and currently a major dry weather supplier of flow to Dry/Coon Creek, the City of Auburn’s Wastewater Treatment Plant located on Auburn Ravine just downstream of the City of Auburn, and effluent from Newcastle and development projects like the Bickford Ranch Project. Appendix C of this DEIR contains a variety of water quality information associated with sample taken from Auburn Ravine in 1995 and includes a U.S. EPA priority pollutant scan. These data show no identified problems with pesticides, although some metals (e.g., copper) are near or exceed California Toxics Rule standards for some samples. Appendix A in the DEIR displays the results of the Department of Water Resources sampling during 2001 near Catlett Road in Sutter County. Copper concentration exceeded California Toxic Rule standards on three occasions during the year. Copper concentrations are a concern, but exceed the standards only occasionally and appear to be of natural origin. It is likely that the local organisms have adapted to these chronic levels over time. . **Source: 1999 DEIR City of Lincoln Wastewater Treatment and Reclamation Facility.**

7. 11/3/1984 Biological Survey by David Vanicek, Sacramento State University, at the Otto Residence, just upstream of Ophir: This was a fish sampling survey, but Vanicek did report a pH of 7.3; dissolved oxygen concentration was 9.0 mg/l; and a conductivity of 195 umhos/cm. **Source: Vanicek report in Department of Fish and Game files, Region 2.**

B. Water Temperature Data

Water temperature data were extracted from various one-time fish sampling projects conducted by the CDFG and are presented below. Most of the data comes from monitoring conducted by Bailey Environmental and includes hourly readings. Due to limitations in the statistical package,

only 3,000 temperature data points can be displayed in a single time series plot. Since daily maximum, minimum, and/or mean temperatures individually are of little value, all data points have been plotted for three time periods that correspond to:

Fall-early winter: September through December; primary fall-run chinook salmon spawning period is November-December.

Winter-spring: January through April; fall-run chinook salmon incubation and rearing and steelhead spawning, incubation, and rearing.

Late spring-summer: May to September; summer rearing for steelhead juveniles.

Data plots for these time periods are presented below to allow the reader to assess the potential of Auburn Ravine to support chinook salmon and/or steelhead trout spawning and rearing. A variety of localized data and literature was reviewed, to provide a generalized understanding of the temperature effects on various life history stages for both chinook salmon and steelhead trout. There is fairly substantial variation in temperature effects noted for most life history stages. However, both chinook salmon and steelhead have a highly adaptable physiology and ability to seek thermal refuge during part of the day, which allows them to tolerate and/or avoid lethal temperatures. Some of the literature sources cite criteria from others and some of the data is based on fish captures with water temperature taken concurrently. Two tables with data and reference are included in Appendix B of this report. Based on this review, the following criteria have been used to indicate what life history stages a particular stream may support at any given time:

<u>Chinook Salmon</u>	<u>°C</u>	<u>Steelhead Trout</u>	<u>°C</u>
Egg and fry development	14.4 (58 °F)	Egg and fry development	14.4 (58 °F)
Juvenile rearing	21.1 (70 °F)	Juvenile rearing	22.2 (72 °F)
Adult migration	21.7 (71 °F)	Adult migration and holding	22.2 (72 °F)

Reference lines for 14.4 °C and 22.2 °C have been provided on Figures 1 through 11, below to approximately represent the water temperatures suitable for salmonid spawning migration, egg and fry development, and juvenile rearing.

1. 3/3/59 One-time Electrofishing Survey Near Goldhill Road Crossing: This survey reported a water temperature of 54.5 °F and air temperature of 74 °F at 1500 hours on this date. Stream flow was estimated at 10 cfs. **Source: Unidentified author memorandum in CDFG, Region 2 files.**

2. 8/27/71 One-time Electrofishing Survey: Water temperature was reported as 68 °F on this date with no time or location given, but the author did state that there was commercial land use adjacent to the site. I speculate that this site was within the City of Lincoln. **Source: Unidentified author memorandum in CDFG, Region 2 files.**

3. 11/3/1984 Biological Survey by David Vanicek, Sacramento State University, at the Otto Residence, just upstream of Ophir: This was a fish sampling survey, but Vanicek did report a water temperature of 14 °C (57 °F) at an estimated flow of 15 cfs, with no time of

measurement given. **Source: Vanicek report in Department of Fish and Game files, Region 2.**

4. 1984 seining and electrofishing for native brood year 1983 fall-run chinook salmon.

Date	Time	Water Temp. (°F)	Location
2/28/84	--	52	Fowler Road
2/28/84	1100	52	Moore Road
5/2/84	--	52	Fowler Road

Source: Unsigned, unidentifiable author note in CDFG, Region 2 files.

5. Moore Road Juvenile Trapping Survey May 9-17, 1992: This data is from a short-term juvenile chinook salmon trapping program on Auburn Ravine. The trapping location was located approximately ½ mile upstream of the Dowd Road extension on the Moore Ranch. I speculate that this site was very near the Moore Road crossing. **Source: Unsigned, unidentifiable author note in CDFG, Region 2 files.**

Juvenile Trapping Survey May 9-17, 1992.

Date	Time	Water Temp. (°F)	Location
5/10/92	1015	60	100 yards downstream of Dowd Rd.
5/11/92	0620	59	100 yards downstream of Dowd Rd.
5/12/92	0700	58	100 yards downstream of Dowd Rd.
5/13/92	0800	59	100 yards downstream of Dowd Rd.
5/14/92	1900	58	100 yards downstream of Dowd Rd.
5/15/92	0700	58	100 yards downstream of Dowd Rd.
5/16/92	0715	58	100 yards downstream of Dowd Rd.

Source: Unsigned, unidentifiable author note in CDFG, Region 2 files.

6. 1995 Monitoring Results from the 1996 City of Auburn, Draft Auburn Wastewater Treatment Plant Stream Study: Water temperature data from this study is presented in Appendix B of this report. These data show that the mean monthly maximum water temperature at station R-1, just upstream of the discharge location did not exceed 15.9 °C during the year. This indicates that this upper portion of Auburn Ravine is suitable for anadromous fish spawning and rearing on a year around basis. Daily water temperature (and certain water quality parameters) were monitored on a 15-minute basis over the period October 4-November 3, 1995. Daily mean values are presented in Tables 6A and 6B and Figure 3 of Attachment 3 in this report. **Source: 1996 City of Auburn, Draft Auburn Wastewater Treatment Plant Stream Study.**

7. Water Temperature Information From Bailey Environmental April 1999 To August 2003: This study begun by the City of Lincoln in April 1999 to provide some baseline information for their EIR on a new wastewater treatment and reclamation facility. Stations were established at Fowler Road, the Nevada Irrigation District gaging station near Highway 65 in Lincoln, just downstream of Nelson Lane, Moore Road, just downstream of Moore Road on the Moore Ranch (identified as Bitter's Property), and on the Aitken Ranch approximately 1 mile

downstream of the Moore Ranch station. Because of continued vandalism problems, the Moore Road station was discontinued in 2000. Although City support for these stations ended in 2001, Bailey Environmental has maintained the data collection since then. All of the stations have suffered some data anomalies (e.g., sensors becoming buried in the sand and recording only the temperature in the sand and not daily fluctuations or someone taking the sensor out of the water). In some instances data are missing completely because of theft or sensor failure. There are some 150,000 readings from these locations. In May 2003, Placer County contracted to add additional stations on Auburn Ravine. Stations were added at the Otto Residence near the town of Ophir in the upper watershed and at the Davis Ranch Bridge off Catlett Road in Sutter County. All of the data for all of the stations has been delivered to the County in electronic format.

For this report, I have provided the current time series for the new stations (Otto and Davis Ranch Bridge; Figures 1 and 2, respectfully) and selected one-year's (Sept. 2002 to Aug 2003) data for three stations (Fowler Road (Figures 3-5), NID gaging station (Figures 6-8), Bitter's Property (Figures 9-11) to demonstrate approximate temperature regimes at each location.

Source: Bailey Environmental, unpublished data.

Figure 1. Water temperature time series for Auburn Ravine at the Otto property, upstream of the Lozanos Road Bridge, during the period June 5 through August 4 2003. This data indicates that this area of Auburn Ravine was suitable for juvenile salmonid rearing during the warmest summer period.

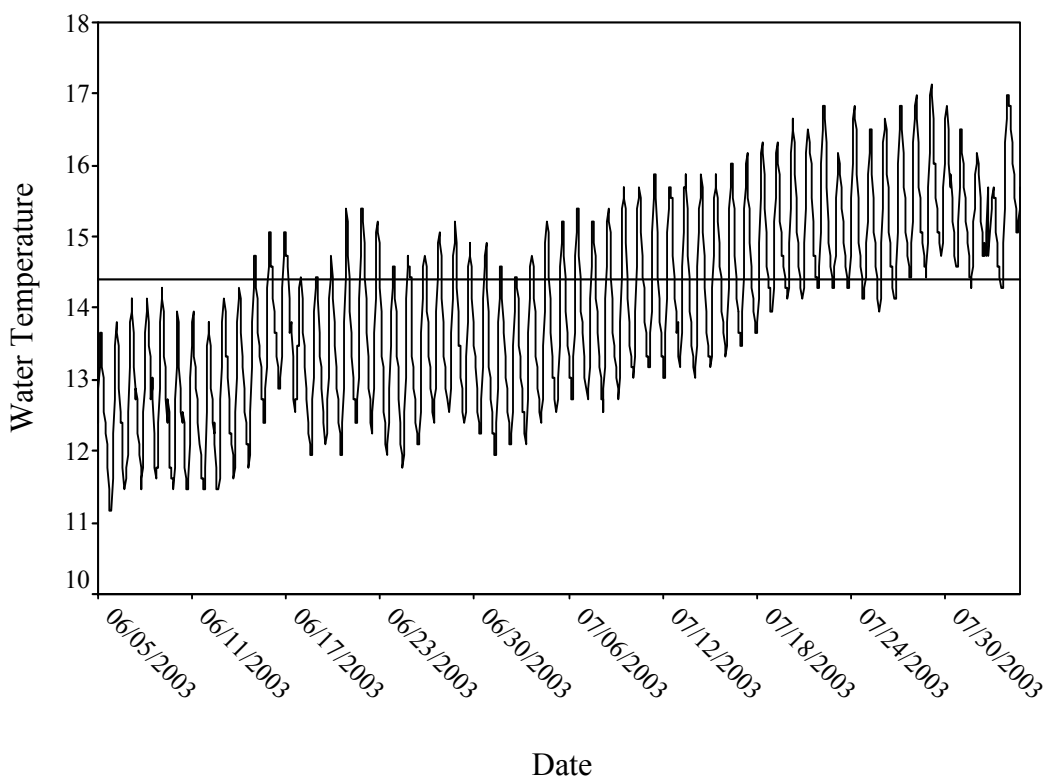


Figure 2. Water temperature time series for Auburn Ravine at the Davis Ranch Bridge in Sutter County, during the period May 28 through August 4 2003. This data indicates that this area of Auburn Ravine was unsuitable for juvenile salmonid rearing during the warmest summer period.

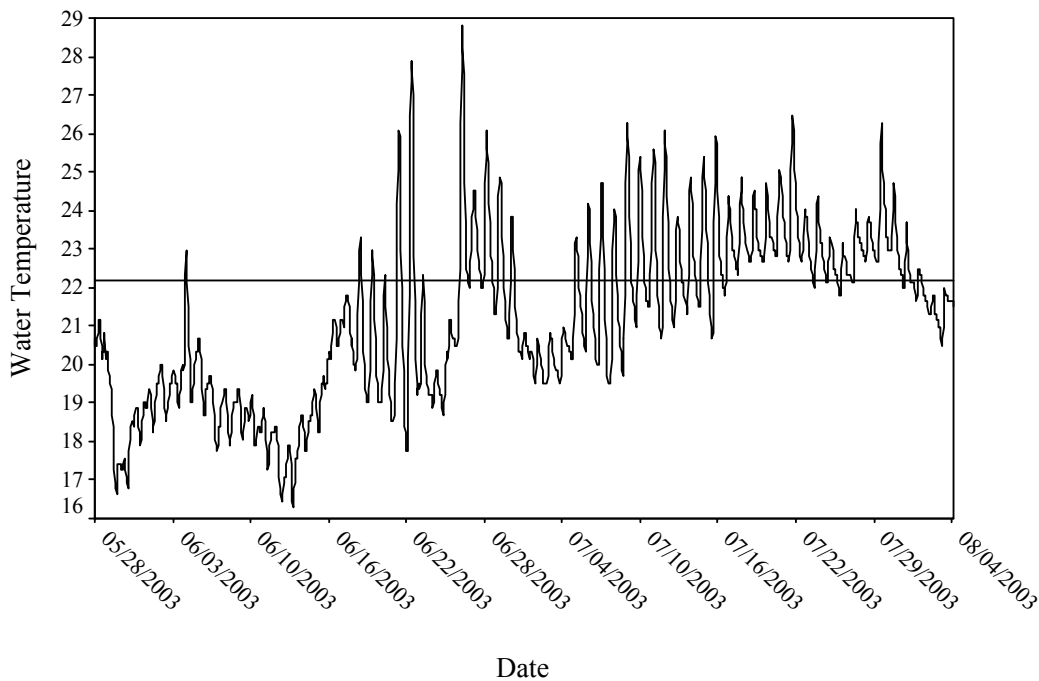


Figure 3. Water temperature time series for Auburn Ravine at the Fowler Road property, during the period September through October 22, 2002 (electronic data from October 22, 2002 to January 29, 2003 was lost). Successful fall-run chinook salmon spawning could have commenced in mid to late October and conditions were suitable for juvenile rearing.

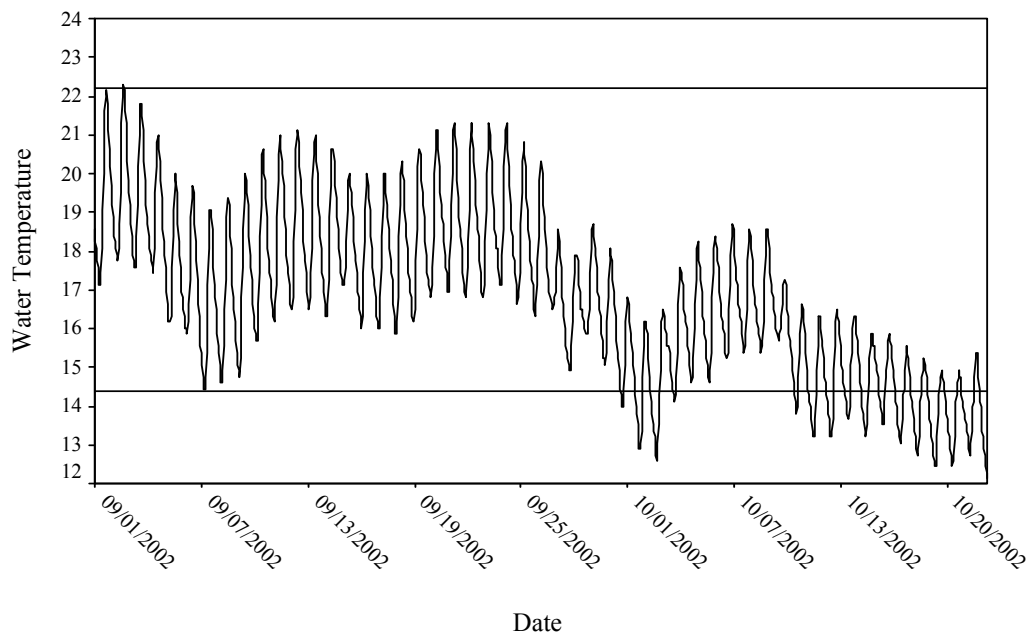


Figure 4. Water temperature time series for Auburn Ravine at the Fowler Road property, during the period January through April 2003. Temperatures are suitable for egg incubation and juvenile rearing.

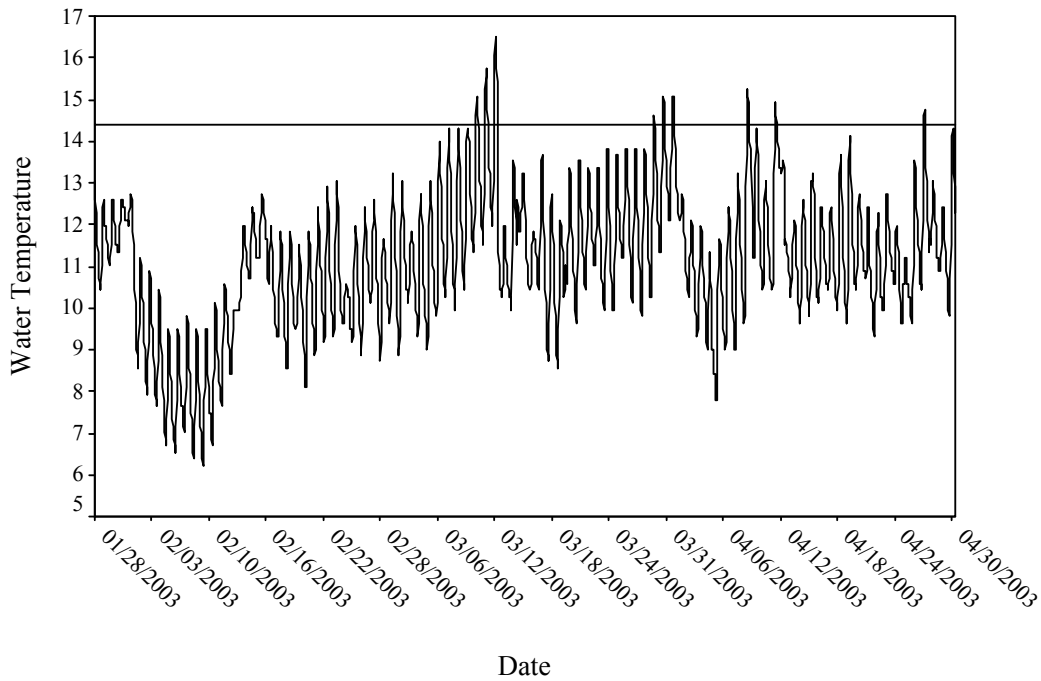


Figure 5. Water temperature time series for Auburn Ravine at the Fowler Road property, during the period May through August 4, 2003. Temperatures are suitable for juvenile rearing. Note the sensor became buried in sand during the latter portion of this time period.

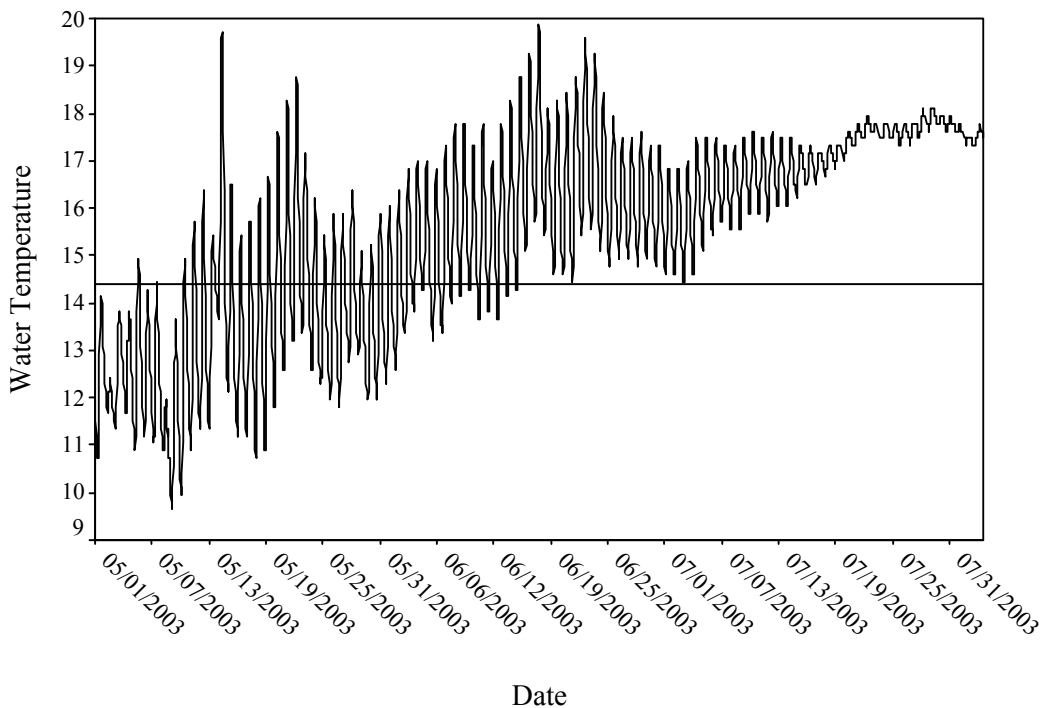


Figure 6. Water temperature time series for Auburn Ravine at the NID gaging station, during the period September 9 through December 2002. Successful fall-run chinook salmon spawning could have commenced in mid to late October. It appears that the sensor may have become buried in the substrate in mid-December.

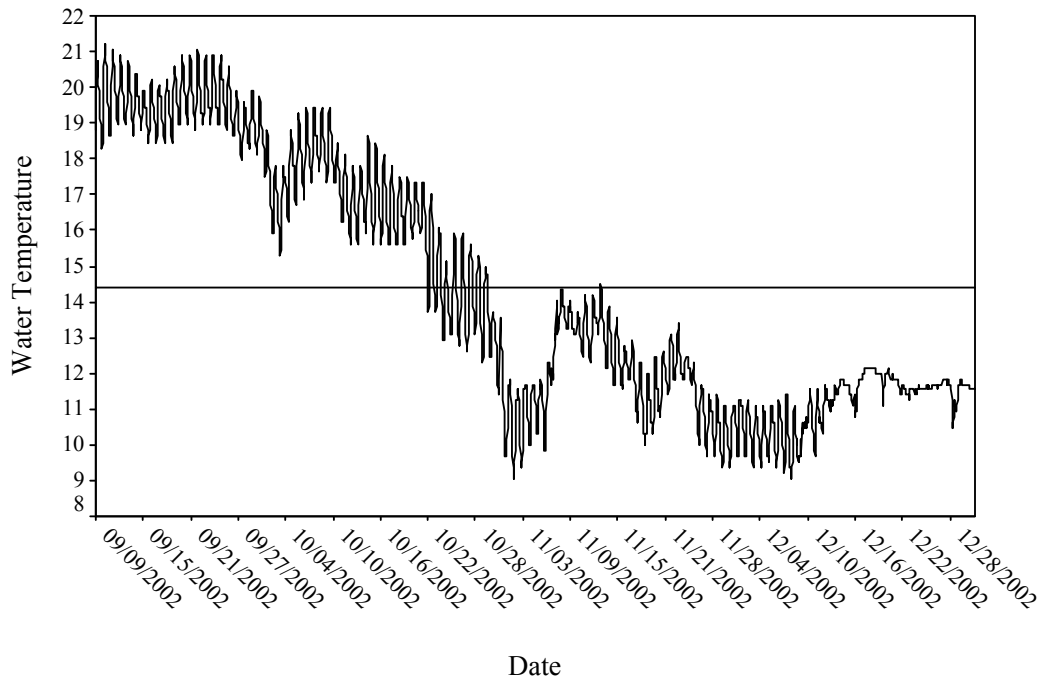


Figure 7. Water temperature time series for Auburn Ravine at the NID gaging station, during the period January through April 2003. Temperatures are suitable for egg incubation and juvenile rearing. The sensor was buried in the substrate until January 29, 2003.

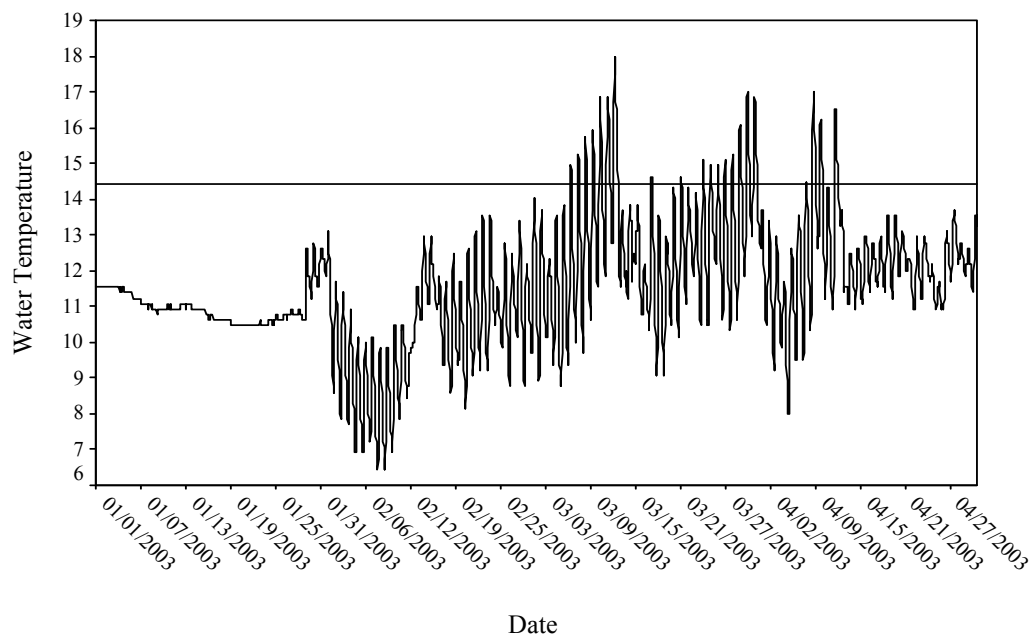


Figure 8. Water temperature time series for Auburn Ravine at the NID gaging station, during the period May through August 5 2003. Temperatures are suitable for juvenile rearing. Note the sensor became buried in sand during the latter portion of this time period.

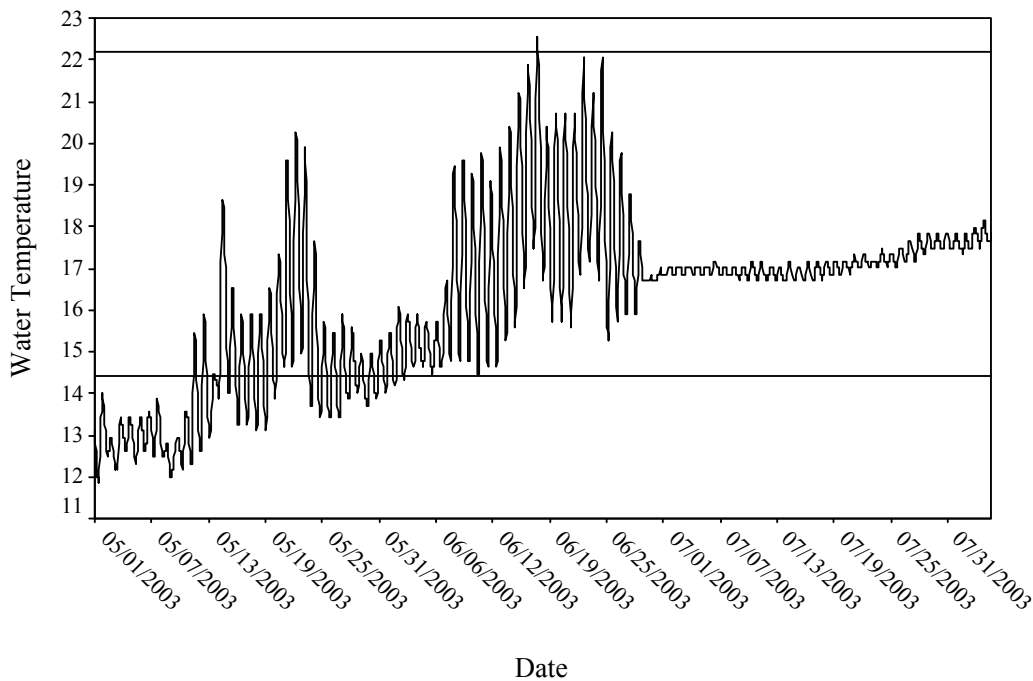


Figure 9. Water temperature time series for Auburn Ravine at the Bitters property, during the period September through October 22, 2002 (electronic data from October 22, 2002 to January 29, 2003 was lost). Successful fall-run chinook salmon spawning could have commenced in late October. However this station contains no spawning gravels and is several miles downstream of suitable spawning habitat.

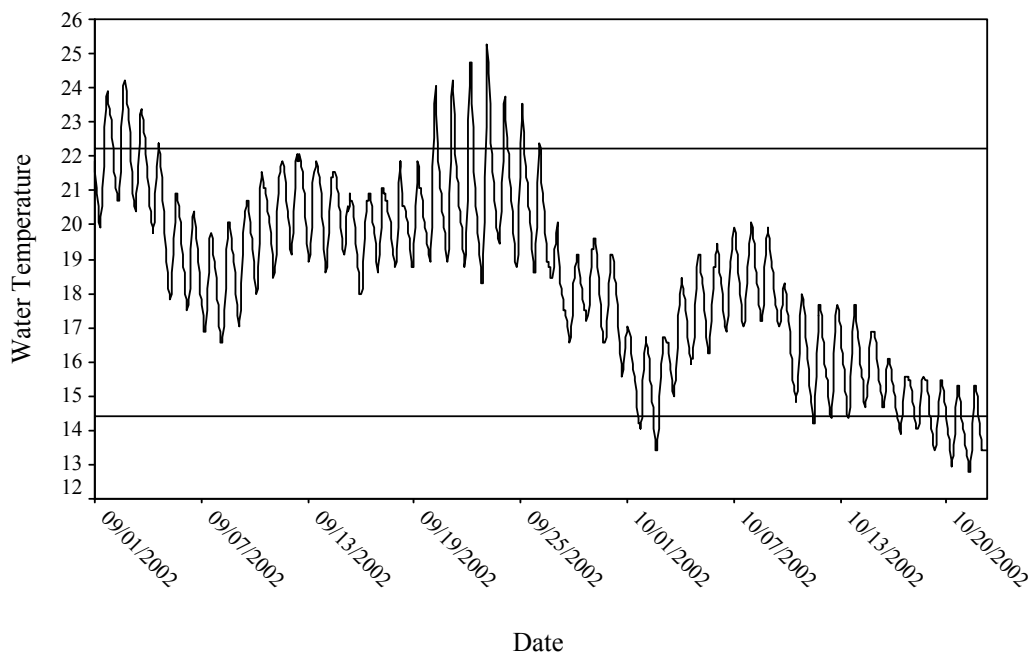


Figure 10. Water temperature time series for Auburn Ravine at the Bitter's property, during the period January 28, 2003 through April 2003. Temperatures are suitable for egg incubation and juvenile rearing.

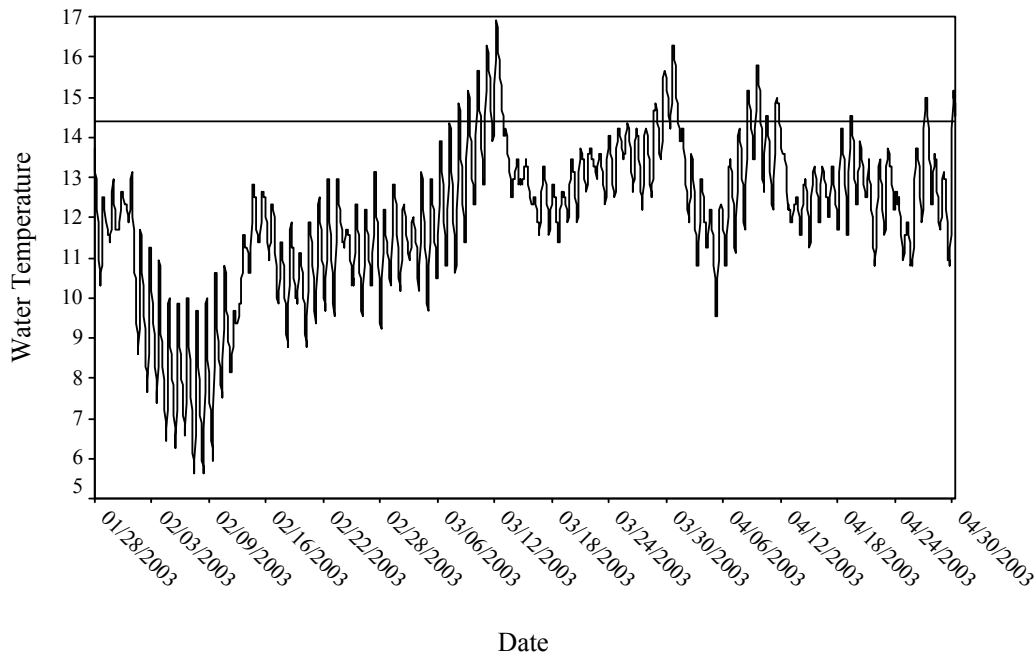
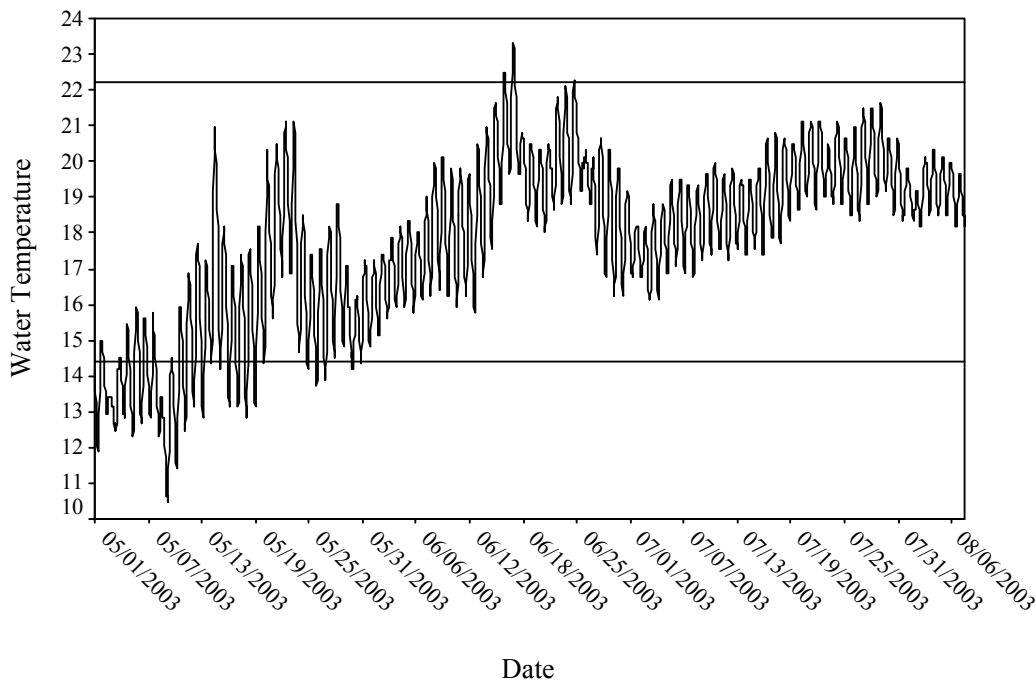


Figure 11. Water temperature time series for Auburn Ravine, Bitter's property, during the period May through August 8 2003. Temperatures are suitable for juvenile rearing.



The water temperature data from the Bailey Environmental study suggest that water temperatures are adequate to support salmonid spawning, egg incubation, and rearing in a number of locations

in Auburn Ravine, although there are unsuitable conditions at Davis Ranch Bridge. The loss of some data due to apparent burying of sensors in sediment points out the problem of high sediment input to Auburn Ravine in many locations.

C. Benthic Invertebrate Data

Three separate sampling programs or projects have sampled benthic macroinvertebrates from various reaches of Auburn Ravine. These sampling efforts are described below:

1. Citizen Monitoring by the Auburn Ravine Group: Samples were collected at Moore Road and Joiner Parkway in March 2000 and at Joiner Parkway in September 2001 (complete data for these three events is presented in Appendix Auburn Ravine 3). Additional samples have been collected more recently, but the analysis results will not be available until early 2004. Data from this sampling is affected by equipment limitations and sampling strategy. First, the equipment used to take the samples does not sample all of the taxa in the stream effectively. Second, taxonomic identification is limited to a maximum of 100 individuals from all taxa, but five of the 10 individual samples collected from the three sampling times and locations contain less than 55 individuals, with two samples containing less than 6 individual organisms. Such low number of individuals in a sample is highly unusual and may indicate severe pollution or habitat problems within the stream. **Source: Benthic Macroinvertebrates sampled from Placer County Streams. Prepared for the Auburn Ravine Group by BioAssessment Services, Folsom, CA., December 2002.**

2. 1997 FEIR Auburn Wastewater Facility Plan: Appendix G of this FEIR summarizes benthic macroinvertebrate sampling that occurred in the fall of 1995 and spring of 1996 in six stream reaches ranging from where Interstate 80 crosses Auburn Ravine, downstream to a reach that includes about 1500 feet of channel downstream of the Lozanos Road Bridge. Table 4 and Figures 9 and 10 in this appendix summarize the results of the fall 1995 sampling. More detailed information on all of the sampling is presented in Attachment 2 of the Draft Auburn Wastewater Treatment Plant Stream Study, August 1996. Results are somewhat mixed, but the Department of Fish and Game concluded that for at least one of the sampling periods, some impairment of benthic macroinvertebrates was noted downstream of the discharge; the FEIR did not find impairment. **Source: 1997 FEIR Auburn Wastewater Facility Plan; 1996 Draft Auburn Wastewater Treatment Plant Stream Study**

3. 1999 DEIR City of Lincoln Wastewater Treatment and Reclamation Facility: This DEIR reports the results of sampling that occurred in early November 1997 at six locations ranging from about the Highway 193 Bridge in the City of Lincoln, downstream to a location located on the Aitken Ranch near the confluence with Orchard Creek. Three samples were taken at each site. A summary of results is presented in Chapter 7 of the DEIR, with more detailed results presented in Appendix F.3. Most of these samples were taken in an area of the stream where the channel is mostly sand bottomed, although two of the sampling sites upstream of Highway 65 do show increased taxon diversity. However, the species richness and diversity are much less than what was recorded in the 1995-96 Auburn study upstream. This result would be expected because of the differences in water temperature regime, channel substrate, and level of nutrients in these downstream reaches. This study confirms the poor habitat quality for aquatic

insects important to rearing juvenile salmonids. **Source: 1999 DEIR City of Lincoln Wastewater Treatment and Reclamation Facility**

D. Physical Habitat Data

1. October 16-19 1995 Physical Habitat Survey Conducted by CH2Mhill for the City of Auburn: This survey was conducted as part of a stream study to document some of the conditions in Auburn Ravine to support the CEQA process for the upgrade and expansion of the City of Auburn's Wastewater Treatment Facility. A level 3 Department of Fish and Game protocol was completed on six stream reaches ranging from Interstate 80, downstream to 1,500 feet downstream from the Lozanos Road Bridge. A summary of the data and findings are presented in Table 5 of Attachment 3 of the 1996 Draft Auburn Wastewater Treatment Plant Stream Study. A listing of data parameters recorded is presented below. Photos were taken of some sections and are available from the surveyors. Bailey Environmental has copies of the original data sheets. These data indicate that this area of Auburn Ravine is dominated by riffles/cascades (50+% in each reach) and about 20% pool habitat in each reach. Estimated stream gradient in the various reaches ranges from 2.2 to 3.9%. Only cursory summary information has been developed. Detailed and/or statistical analysis is possible if needed.

Parameters Recorded	Parameters Recorded	Parameters Recorded
Date Sampled	Water Depth at Pool Tail Crest (ft)	Left Stream Bank Soil Composition
Habitat Unit Number	Dominant Substrate Size	Right Stream Bank Soil Composition
Habitat Type	Subdominant Substrate Size	Left Stream Bank Vegetation Composition
Side Channel Habitat Type	Shelter Rating	Right Stream Bank Vegetation Composition
Mean Length of Habitat Unit (ft.)	Percent Shelter Type in Habitat Unit	Percent Left Bank Vegetated
Mean Channel Width (ft.)	Percent Total Canopy	Percent Right Bank Vegetated
Mean Water Depth (ft.)	Percent Coniferous Trees	Percent Deciduous Trees
Maximum Water Depth (ft.)		

Source: 1996 Draft Auburn Wastewater Treatment Plant Stream Study; Bailey Environmental, unpublished data from CH2Mhill.

2. 1999 DEIR City of Lincoln Wastewater Treatment and Reclamation Facility: Appendix F.2 of this DEIR contains all of the information regarding a 3-day survey of Auburn Ravine beginning at the South Sutter Water District diversion on the Aitken Ranch upstream to the Joiner Parkway Bridge in the City of Lincoln. The survey included a cursory assessment of water quality, sediment size and condition, channel structure, and vegetative cover. The survey indicates that shallow runs and glides dominate the channel. The bottom substrate is primarily sand with some coarser gravel. Channel complexity was greatest in areas where riparian vegetation and tree canopy was highest. Several beaver dams, debris dams, and man-made

diversion dam sites were also recorded. **Source: 1999 DEIR City of Lincoln Wastewater Treatment and Reclamation Facility**

3. 2003 Placer County Spawning Gravel Survey: During the summer of 2003, Placer County funded a survey to examine steelhead trout spawning gravels in this drainage (as well as others). No data are currently available from this effort. However, based on a review of the sampling protocol, it appears that little, if any useful additional information will be obtained.

4. 2003 Placer County Stream Videography Project: On March 12, 2003 this Auburn Ravine was videotaped from the air, beginning the Eastside Canal, upstream to the Wise Powerhouse near Auburn. Review of the video footage shows the riparian area of the stream varies from very poor quality (downstream areas) to very high quality (upstream of Fowler Road). Also, this footage revealed extensive bank erosion that is contributing to the sediment load in the stream. The proportion of the excessive sediment load attributable to bank erosion versus decomposition of underlying rock formations is unknown. Sediment contributions from land disturbing activities and roadways are also unknown. Based on the video footage and field observations over a period of more than 4 years, I consider the area of stream downstream from about the mid-point between Nelson Lane and Joiner Parkway Bridge as only a migratory corridor for anadromous fish. This area is mostly sand bottomed, low gradient channel with little potential for accommodating good quality spawning or rearing habitats for anadromous fish. The area between just downstream of the Joiner Parkway Bridge and locations upstream appears to be suitable for chinook salmon spawning and rearing, with some steelhead rearing also possible in this area. The area upstream of Fowler Road appears to be suitable spawning and rearing area for both chinook salmon and steelhead trout. This upstream area has a higher gradient, less sediment in the gravels, and high levels of desirable habitat complexity than observed in downstream areas.

E. Fishery Resource Data

1. Documented Fish Species Present in the Stream

Redear sunfish	Prickly sculpin
Black bullhead	Pumpkinseed
Bluegill	Golden shiner
Largemouth bass	Lamprey sp.
Green sunfish	California roach
Mosquitofish	Carp
Hardhead	Rainbow trout/steelhead
Brown trout	Sacramento sucker
Speckled dace	
Fall chinook salmon (native)	
Fall chinook salmon (introduced – Feather River Fish Hatchery)	
Fall chinook salmon (introduced – Nimbus Fish Hatchery)	
Spring chinook salmon (introduced – Feather River Fish Hatchery)	
Sacramento pikeminnow (formerly known as Sacramento squawfish)	

Source: California Department of Fish and Game, Region 2 files; 1999 DEIR City of Lincoln Wastewater Treatment and Reclamation Facility; 1996 Draft Auburn Wastewater Treatment Plant Stream Study.

2. Fish Stocking Records

The following stocking records were found in CDFG's Region 2 files:

Species	Origin	Date	Size (No./lb)	Mean Length*	Number Stocked	Location
Brown trout	Mt. Shasta	6/25/30			10,000	Dutch Ravine tributary near Goldhill Road
Brown trout	Mt. Shasta	7/1/32			10,000	Dutch Ravine tributary near Goldhill Road
Rainbow trout	Mt. Shasta or possibly Bear River	1948				Note that stream was planted, but no planting receipt
Rainbow trout	Bear River	7/28/49	232	56	4,988	Could be near Wise Powerhouse or east
Rainbow trout	Bear River	1950	245	55	1,989	USGS Quad description not in Auburn Ravine Watershed
Rainbow trout	Mt. Shasta	7/19/51	224	56	2,602	Near Wise Powerhouse
Rainbow trout	Mt. Shasta	7/25/52	256	54	2,000	Near Wise Powerhouse
Rainbow trout	Mobile?	7/15/53	256	54	2,000	Near Lozanos Road
Rainbow trout catchables		5/10 to 7/4/59				Auburn – probably kids fishing program
Brown trout		5/10/89		229	500	Upstream of Marguarite Mine in Auburn – fish kill mitigation
Spring chinook salmon	Feather R. FH	2/20/85	344	54	77,400	Moore Road
Fall chinook salmon	Feather R. FH	1/31/86	480	48	24,000	Garden Bar Road
Fall chinook salmon	Feather R. FH	1/27/87	800	41	50,400	Highway 65
Fall chinook salmon	Nimbus FH	1/13/89	1,072	37	100,700	Goldhill Road.?

Fall chinook salmon	Nimbus FH	1/25/90	1,245	35	124,500	Goldhill Road
Fall chinook salmon	Feather R. FH	2/25/92	764	41	101,612	Goldhill Road
Fall chinook salmon	Feather R. FH	2/19/93	1,165	36	100,190	Goldhill Road
Fall chinook salmon	Nimbus FH	2/3/94	1,100	37	107,800	Goldhill Road
Fall chinook salmon	Nimbus FH	2/3/95	1,040	37	99,840	Goldhill Road
Fall chinook salmon	Nimbus FH	1/10/96	1,200	36	104,400	Goldhill Road
Fall chinook salmon	Nimbus FH	2/27/97	760	41	102,600	Goldhill Road

*Length estimates (mm) from Fish Hatchery Management, Fish and Wildlife Service, 1992.

3. Adult Spawning Timing, Distribution, and Population Estimates

- 1991 Memorandum entitled “Recollection of Auburn Ravine Creek, Coon Creek and Dutch Ravine Creek by Auncle “Slim” Goodall”:** This memo documents the memories of Mr. Goodall regarding his fishing and species caught starting in 1939 or 1940. Mr. Goodall fished Auburn Ravine from the Wise Powerhouse downstream to Lincoln. He states it “... was a known fact that steelhead and salmon came up to the Wise Powerhouse back in those days.” He personally caught 18” fish and (say) 20” fish were routinely caught in the early days. In the 1960’s fishing really slowed down. **Source: May 26, 1991 Conversation documented by Ron Otto.**
- 1964 Fall-Run Chinook Salmon Spawning Survey by Eric Gerstung:** Gerstung conducted a survey of 500 ft. of stream at the Fowler Road Bridge (noted in the records as Silva-Bertholt Bridge in the original memo) on 11/23/64. He saw no carcasses and 15 live fish. He estimated the run size to be 300 fish and indicated, for streams in the area, that the run size was much greater in 1963, although no specific reference to any particular stream was noted. The information on the 1963 run size is not in the CDFG files reviewed. Water clarity was reported as muddy and flow estimated at 25 cfs. **Source: May 25, 1965 memorandum in CDFG, Region 2 files.**
- December 6, 1985 Spawning Survey:** Auburn Ravine was surveyed for fall chinook salmon on 12/6/85. The stream was survey from approximately ½ mile upstream of Goldhill Road crossing to about ½ mile downstream of the same crossing. There had been a week of rain; visibility was estimated at 18”, and flows at 40-50-cfs. A 4ft. waterfall was noted approximately ½ mile upstream of the road crossing. Twelve adult chinook salmon were observed actively spawning from the fall to about ½ mile downstream from the bridge. Most chinook salmon were about 28” but one 40” male was observed. Spot checks were made at Bridge Lane and Fowler Road with no fish observed. Run size was estimated as 100 fish. **Source: Unsigned, unidentifiable author note in CDFG, Region 2 files.**

- **Fall 1986 Salmon Spawning Surveys in the City of Lincoln:** Fred Meyer conducted surveys on four sections of Auburn Ravine in November of 1986. The first survey was conducted on 11/3/86 in the City of Lincoln. Meyer saw 12 salmon. Flow was estimated at 10-12 cfs, but higher flows had occurred before the survey. A second survey of two stream segments was completed on 11/13/86. The first segment included walking for 25 minutes downstream from Highway 65. Fred reported 3 unmarked, live salmon; 3 obvious redds; and 4 carcasses. A local citizen reported seeing 40 fish. The second segment surveyed was from Highway 65 upstream to the Highway 193 Bridge crossing. Meyer recorded 7 dead; 1 live; and over 50 redds. He also reported broken spears and a line of eggs going up the bank. He estimated both age II and age III fish. The population at 200 fish with an additional 100-200 poached. His last survey occurred on 11/17/86 at the Goldhill Bridge with no fish observed. **Source: Fred Meyer memorandum in CDFG Region 2, files.**
- **1/2/92 John Hiscox Memorandum:** In this memorandum, Hiscox documents information regarding a fish sample he received from Ron Otto, in October 1991. Otto states that the fish was caught in early September 1991 and frozen before being given to Hiscox. Hiscox noted the following: fish was 16.2" long and weighed 1.45 lbs.; silver along the sides, no parr marks or striping; fish were intact with no feathering (hatchery origin fish often have deformed fins because of rubbing against the concrete raceway bottoms or walls). Scale analysis indicated that this fish was 2 years old, with widely space circuli and well defined annuli. Hiscox's conclusion is that fish was anadromous. **Source: 1/2/92 Memorandum from John Hiscox, District Fisheries Biologist, CDFG Region 2, files.**
- **11/30/94 Nelson Lane Observations:** Six salmon were sighted below the diversion dam just downstream of Nelson Lane near the Lincoln Airport. The dam was removed two days later and the author heard of salmon sightings further upstream, but was unable to confirm this information. **Source: Unsigned, unidentifiable author note in CDFG, Region 2 files.**

4. Juvenile Distribution and Sampling Data

- **March 3, 1959 Electrofishing Sample:** A one-day electrofishing sample was collected from Auburn Ravine near the Goldhill Road Bridge on 3/3/59. A 350 ft. section was electrofished. Flow was reported as 10 cfs, channel width 15 ft., and pools 2-6 ft. deep. Good fishing was reported upstream of the Bridge. Species captured included: rainbow trout (few); brown trout; suckers; hitch; green sunfish (few). **Source: Unsigned, unidentifiable author note in CDFG, Region 2 files.**
- **Spring 1965 Fall-Run Chinook Juvenile Emigration Survey by Eric Gerstung:** Gerstung began trapping downstream migrant fall-run chinook juveniles in Auburn Ravine just downstream of Fowler Road (noted in the files as Silva-Bertholdt Road) in mid-February 1965 and continued through mid-March (original data sheet missing from the files). Sampling was with a "riffle" trap or perforated plate trap. The trap fished a

total of 515 hours and captured 63 juvenile chinook salmon. No other fish species catch composition or specific data is reported. **Source: May 25, 1965 memorandum in CDFG, Region 2 files, handwritten draft of May 25, 1965 memo, and other handwritten notes.**

- **August 1971 One-time Seining Event:** The Department of Fish and Game conducted a one-time seining event on August 27, 1971 at an undefined location in Auburn Ravine. Although no location is given, the stream channel was recorded as being three feet wide, water depth 0.25 ft. deep, with commercial land use next to the stream. Given these conditions, this location was near the City of Auburn. A 50-foot section was electrofished. Catch composition is reported as: 3- rainbow trout (2.2", 3.2", 8.3") and 1- green sunfish (3.9"). **Source: Unsigned, unidentifiable author note in CDFG, Region 2 files.**
- **March 1979 Electrofishing Survey:** The Department of Fish and Game conducted a one-time electrofishing survey at three locations on Auburn Ravine in and near the City of Auburn on 3/20/79. **Source: Unsigned, unidentifiable author note in CDFG, Region 2 files.**

Location	Length Fished	Catch Composition
Auburn Ravine Rd. at Persimmon Ave.	130 yds.	12-rainbow trout (4-7"); 2- green sunfish ((7-8"); 8- roach (1-3")
Placer Terrace Apt. near freeway	100 yds.	10- rainbow trout (4-8" in excellent condition); 1- green sunfish (5"); 1- largemouth bass (2"); 8- roach
Ophir Rd. at Stonehouse Rd. below old sewer plant	100 yds.	No fish captured

Source: Unsigned, unidentifiable author note in CDFG, Region 2 files.

- **1984 Seining and Electrofishing For Native Brood Year 1983 Fall-Run Chinook Salmon:** Water temperatures for this sampling effort are reported above. The following sampling results were reported: **Source: Unsigned, unidentifiable author note in CDFG, Region 2 files.**

Date	Effort	No. chinook	Length Mode (mm)	Length Range (mm)	Other Fish Species	Location
2/28/84	2 seine hauls	1	--	41	1- sucker	Moore Rd.
2/28/84	2 seine hauls	0	--	--	8-suckers	Fowler Rd.
4/2/84	1 seine haul	7	47	43-68	4- rainbow trout; 11- squawfish*; 8- suckers	Fowler Rd.
5/2/84	1 seine haul	2	--	67, 68	11- rainbow trout	Fowler Rd.

5/24/84	1 seine haul	0	--	80, 81	1-sucker	Fowler Rd.
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* Sacramento squawfish are now known as Sacramento pikeminnow.

Source: Unsigned, unidentifiable author note in CDFG, Region 2 files.

- November 1984 Electrofishing Survey by Sacramento State University Professor Dave Vanicek at the Otto Residence:** Dr. Vanicek conducted an electrofishing survey of approximately 1,000 ft. of stream at the Otto Residence off Wise Road just downstream from the City of Auburn's wastewater treatment facility on 11/3/1984. Water quality and water temperature measurements are reported above. Fish species catch is reported: **Source: Copy of Vanicek's Report in CDFG, Region 2 files.**

Fish Species	N	Fork Length of Individuals (mm)
speckled dace	1	88
green sunfish	1	166
Sacramento sucker	5	138, 146, 148, 153, 202
rainbow trout	26	58, 75, 81, 88, 95, 96, 98, 99, 100, 101, 101, 102, 105, 106, 112, 115, 116, 118, 121, 122, 123, 127, 133, 134, 146, 262

Source: Copy of Vanicek's Report in CDFG, Region 2 files.

- 1985 Electrofishing Record from Dutch Ravine:** The Department of Fish and Game conducted a one-time electrofishing survey in Dutch Ravine at Dutch Court road crossing on 3/26/85. Water temperature was reported as 61 °F at 1500 hours. Stream is described as low gradient; some gravel; much sand; canopy heavy with berry, alders, and buckeye. A 100-foot section was sampled with one pass and had the following reported catch:

squawfish – 2 young of the year and 2 – adults

suckers – 4 young of the year and 4 adults

one brown trout greater than 150 mm

one rainbow trout less than 150 mm and 2- rainbow trout greater than 150 mm

Source: Unsigned, unidentifiable author note in CDFG, Region 2 files.

- 1990 Michael Sarkisian Letter:** Mr. Sarkisian of Newcastle, wrote a letter to the Department of Fish and Game in which he claims to have seen approximately 1,000 salmonid fingerlings, which he believes to be steelhead, in isolated pools west of Lincoln. **Source: Letter from Mr. Sarkisian, received 6/16/1990, CDFG, Region 2 files.**
- 1993 Fish Kill Report: Source:** A fish kill occurred on October 26, 1993 as a result of a discharge from the City of Auburn's wastewater treatment plant near Auburn. All fish for approximately 1-2 miles downstream from the discharge location were apparently killed. Estimates of the number killed are based on electrofishing the next day, upstream from the discharge. Dead fish were reported as rainbow trout, sucker, squawfish, and hardhead. The official loss report estimates the losses as 6,400 rainbow trout from 1.5"-10" in length; 8,000 suckers from 4"-18" in length; and 950 hardhead 3 inches in length. No estimates of squawfish losses are reported. Local citizens reported rescuing several 12"-16" rainbow trout, all of which later died. The length range of rainbow trout

indicates probably 4 age classes were present. **Source: October 26, 1993 Fish Kill Report, CDFG, Region 2 files.**

- **1995-1996 Monitoring Results from the 1996 City of Auburn, Draft Auburn Wastewater Treatment Plant Stream Study:** Attachment 3 of this document describes the results of electrofishing subsampling that occurred in six reaches of Auburn Ravine downstream from Interstate 80 to a point approximately 1,500 feet downstream from the Lozanos Road Bridge. Sampling was conducted in October 24-28, 1995 and again from April 4-9, 1996. Sampling results for steelhead/rainbow trout are presented in Attachment 3, Tables 8a and 8b, respectively. The October 1995 results indicate an extremely productive trout stream with 4 of 6 reaches having an estimated steelhead/rainbow trout biomass exceeding 125 lbs/linear mile of stream. April 1996 biomass estimates ranged from 14-62 lbs/linear mile but average fish size remained about the same, with only small increase in average length. I speculate that much of the biomass emigrated to downstream areas and/or to the ocean as steelhead smolts. This scenario would be consistent with a normal steelhead stream and appears to be supported by data presented in Figures 14 and 15 in Attachment 3. **Source: 1996 City of Auburn, Draft Auburn Wastewater Treatment Plant Stream Study.**
- **1999 DEIR City of Lincoln Wastewater Treatment and Reclamation Facility:** This DEIR (Appendix F, Table F-4) documents fish sampling conducted by Jones and Stokes Associates in November 1997 and Bailey Environmental/Dean Carrier and Associates in November 1998 (Appendix Table F-5). These sampling efforts document many of the species listed in the “Documented Fish Species Present in the Stream” section of this report. The major exception is that no chinook salmon were captured, but this would be expected because of the low water which prevented adult access in November 1997 or 1998 and juveniles would have left the stream the previous spring. Bailey Environmental sampling documented the presence of steelhead smolts (juveniles approximately 150 in length and having silvery sides with no parr marks). Approximately 50% of the juvenile steelhead captured had or were under going parr/smolt transformation. The remaining 50% had not yet started to turn color, but were on average about 25 mm shorter. These fish would be expected to smolt before spring and move to the ocean during spring flows. **Source: DEIR City of Lincoln Wastewater Treatment and Reclamation Facility, September 1999.**
- **Reports of “Half-Pounder” Steelhead in Auburn Ravine:** There is a growing body of anecdotal evidence to suggest that steelhead that exhibit this particular life history pattern enter Auburn Ravine in the spring and migrate to upstream areas. Half-pounders exhibit an unusual life history pattern in that they migrate as young adults (usually spending only one year in the ocean or estuary) into their natal streams in late spring and through the summer if stream conditions are right. A number of streams on the coast of California have half-pounder runs. Information that supports such a finding includes:
 - (a) Conversations with Dr. Ron Otto, who lives in the Ophir area, who is a highly knowledgeable steelhead fisherman. Otto has continually caught steelhead in the 15”-20” range near his home on Auburn Ravine during the summer and early fall time periods,

certainly before fall rains and removal of diversion dams would have permitted fish to migrate into the stream. He has documented lengths and has photos of fish that are obviously silvery in color and have not been in freshwater for any length of time.

(b) The conclusion of John Hiscox, Department of Fish and Game District Biologist that a fish caught in early September by Dr. Otto was anadromous in origin (see details above in this chapter).

(c) Statements on page 3-80 of the DEIR/DEIS City of Auburn Wastewater Treatment and Disposal Master Plan for the City of Auburn, prepared by Quad Consultants and Dewante and Stowell Consulting Engineers. This document indicates that half-pounders are known to utilize Auburn Ravine for spawning during the winter. No specific reference is cited. However, Dennis McEwan, Department of Fish and Game steelhead specialist (Department of Fish and Game Fish Bulletin 179 "Contribution to the biology of Central Valley Salmonids", Volume 1) states that no summer steelhead runs occur in the Central Valley. The behavior of these fish in Auburn Ravine, entering in late spring is atypical of normal winter migrating adults found in the rest of the Central Valley.

(d) Observations by Mark McClure, Lincoln resident, to Randy Bailey, Bailey Environmental. McClure said that on July 9, 2002 he had observed three steelhead (about 20" to 22" long) in a pool approximately 100 yards downstream from the Joiner Parkway Bridge in the City of Lincoln. Mr. McClure is a City of Roseville fireman and an avid fisherman. I have questioned him on several occasions regarding his general knowledge of fish and fish behavior. I find his account totally plausible based on his knowledge of the species and the water temperature data for that time period recorded at the NID gaging station located about 1 mile upstream from the subject location.

(e) Riley Swift, owner of Restoration Resources, reported to me that Tim Pafford, a fish biologist employed by Riley, had seen what he (Pafford) believed to be half-pounders jumping at the face of the South Sutter Diversion Dam on the Aitken Ranch in May 2003 or possibly 2002. This report is especially important because the timing of the installation of South Sutter's various diversion dams usually occurs in mid-April, after being down all winter when normal adult winter steelhead would be migrating.

(f) A 5/10/94 letter from the Department of Fish and Game (copy in Region 2 files) to Jim McKeivitt (at that time head of the Central Valley Project Improvement Act Program for the U.S. Fish and Wildlife Service) regarding the needs for Auburn Ravine. One of the concerns expressed by the Department was the need to get steelhead upstream of NID's Auburn Ravine #1 Diversion Dam [I assume] on a consistent basis. Fish move over the dam (located upstream of Goldhill Road and consisting of an 11 ft. high concrete arch dam across the channel) on high flows. The Department suggests that a fish ladder is needed at this location (See a more detailed discussion of fish passage at this site below).

F. Fish Passage or Screening Data

1. Man-Made Structures or Pumping Stations. The following information is abstracted from the reconnaissance level survey of the various diversion dams located in Auburn Ravine, completed by James Buell, PhD and reported in detail in the April 2002 Auburn Ravine/Coon Creek Ecosystem Restoration Plan in the watershed area of interest to this assessment. The reader should note, that none of the recommendations for action considered the presence and migratory timing of half-pounder steelhead migration in the spring or early summer. Since this concern has been more fully documented, Dr. Buell and I have discussed ways in which to provide upstream fish passage for half-pounders. Recommendations developed during these discussions are presented. These recommendations would provide implementable solutions to fish passage at relatively modest cost at most locations.

- **Nevada Irrigation District Gaging Station**

(a) **Location:** The site is located about 1/4 mi downstream of SR 65 in the City of Lincoln.

(b) **General Description:** This structure is a full channel width concrete section installed in association with a recording stream gage owned and maintained by Nevada Irrigation District. The section forms a broad flume with vertical sides, an upward-sloping approach, and a level crest with an ogee shape descending to a horizontal apron which spills onto large boulders to dissipate energy and prevent undermining. The flume and crest section is 25 ft wide, with flaring upstream and downstream sidewalls.

(c) **Assessment:** This structure is a significant impediment to upstream anadromous fish migration at all but extremely high flows, when the structure would become drowned out. Good passage requires either swim-up conditions (preferred) or the combination of a plunge pool with a standing wave, height of the obstruction less than the leaping ability of the fish, and quiescent “receiving water” conditions at the top of the obstruction into which the fish can leap. None of these conditions is met at this site under most stream flow conditions (when the structure is drowned out, swim-up conditions are likely present). Since this assessment was initiated, NID has performed maintenance at the downstream edge of this structure. A field of boulder riprap was placed below the downstream lip of the structure to prevent further erosion and undermining of the structure. This configuration is now probably a barrier to fish passage under low to moderate flows.

(d) **Priority for Attention:** High.

(e) **Alternative Approaches:**

Formal Fishway – This alternative would involve construction of a formal engineered fishway around the site. Recommended configuration for this alternative is a vertical slot and orifice fishway of standard design. Location should be on the right bank if

maintenance access across adjacent private land can be obtained (to reduce poaching and vandalism risks) or on the left bank if such access can not be obtained. If the structure is constructed on the left bank, which would be easily accessible to vandals and poachers (high risk at this site), the fishway should be completely covered with a heavy-duty locked grating. Maintenance during the migration season should be at least weekly, to keep the fishway clear of obstructing debris. If this alternative is implemented, the entire complex would have to be re-rated to calibrate the stream gage. Some minor loss of precision may result due to increased hydraulic complexity, especially if debris is allowed to accumulate in the fishway.

Pool-and-Chute Replacement – This alternative would involve the replacement of the existing concrete section with an engineered “Pool-and-Chute” fishway spanning the entire channel. These structures are essentially a series of shallow-angle “V” weirs with a central notch to the structure floor about 1 ft in width. Although relatively new in design, this structure is well tested, and provides good passage conditions for both adult and juvenile anadromous fishes under a very wide range of flow. The formal design of these structures is conducive to the development of rather precise stage-discharge relationships, making this alternative a suitable substitute for the existing section at this stream gaging site. Naturally, the gage would have to be re-rated, but the resulting precision would likely be as good or nearly as good as the existing flume section, and superior to the combination of the existing structure and a circumventing formal fishway.

Backwater Existing Section – This alternative would involve placing a series of low, very shallow angle “V” weirs across the channel downstream of the existing concrete section to backwater the existing section to the point where swim-over conditions were achieved for most stream discharges typical of the anadromous fish upstream migration season. Implementing this approach would seriously compromise the precision of the gaging station. More importantly, this approach would significantly reduce the conveyance capacity of the channel immediately downstream of the gage, resulting in increased flood risk. Although technically feasible with accompanying flood protection measures, this approach is probably not practical.

(f) **Recommendation:** The “Pool-and-Chute Replacement” alternative is recommended.

- **Davis Dam**

(a) **Location:** Davis Dam is located between the Pleasant Grove Road crossing and the Union Pacific Railroad tracks in Sutter County.

(b) **General Description:** Davis Dam is a seasonal flashboard dam in a highly modified reach of Auburn Ravine on the valley floor. The 12 ft wide rectangular concrete abutments are 40 ft apart, connected by a concrete slab on the channel invert. A major water turnout is located immediately upstream on the right bank, consisting of an unscreened 42 in diameter culvert with a knife gate, operated by a wheel. This dam is in operation annually from 15 April to 15 October.

(c) **Assessment:** The seasonal operation of this dam means that it is not a significant impediment to upstream-migrating anadromous fish in most if not all years. This facility is on the valley floor in an area where water temperatures are not conducive to year-round rearing of anadromous fish. In addition, most active downstream migration of smolts in most years is outside the irrigation diversion season. For these reasons, screening the turnout adjacent to Davis Dam, and other diversions (pumped or gravity) in this area should be considered a low priority action, if it is justified at all.

(d) **Priority for Attention:** Low.

(e) **Alternative Approaches:** None developed.

(f) **Recommendation:** No change.

- **Tom Glenn Dam**

(a) **Location:** Tom Glenn Dam is located on Auburn Ravine

(b) **General Description:** Tom Glenn Dam is a seasonal flashboard dam on a highly modified reach of Auburn Ravine on the valley floor. The trapezoidal abutments are 40 ft apart, connected by a rough, 8 ft broad ogee-shaped concrete sill with a downstream transition into a short “flip-lip”. The “flip-lip” is broken away on the right side, but the structure does not appear to be at risk of undermining. Tom Glenn Dam is operated annually from 14 April through 15 October.

(c) **Assessment:** The seasonal operation of this facility means that it is not a significant impediment to upstream-migrating anadromous fish in most if not all years. In spite of the elevated sill, in its flashboards-out condition, this structure does not present a significant impediment to upstream anadromous fish migration, partially because of the broken condition of the “flip-lip” near the right abutment; if this were repaired, this structure would become a minor impediment at low flows, but at higher flows, typical of most upstream migration periods, a swim-over condition would be present. This facility is on the valley floor in an area where water temperatures are not conducive to year-round rearing of anadromous fish. In addition, most active downstream migration of smolts in most years is outside the irrigation diversion season.

(d) **Priority for Attention:** Low.

(e) **Alternative Approaches:** None developed.

(f) **Recommendation:** No change.

- **Aitken Ranch Dam**

(a) **Location:** This dam is located on the Aitken Ranch, just west of Fiddymment Road.

(b) **General Description:** Aitken Ranch Dam is a seasonal flashboard dam on a modified reach of Auburn Ravine on the valley floor. The trapezoidal abutments are 26 ft apart and are connected with a concrete sill even with the channel invert. The abutments support a flat car bridge. Aitken Ranch Dam is operated annually from 15 April through 15 October.

(c) **Assessment:** The seasonal operation of Aitken Ranch Dam means that it is not a significant impediment to upstream-migrating anadromous fishes in most years. This modified (channelized) reach of Auburn Ravine has physical habitat features which could support rearing juvenile anadromous fish, and temperatures in this part of the valley floor during at least part of the irrigation season would also support populations of these fish in some years. Although no diversion is located in the immediate vicinity of this structure, those within its influence upstream are unscreened, and may be candidates for screening.

(d) **Priority for Attention:** Low for dam; medium for unscreened diversions in this reach.

(e) **Alternative Approaches:** None for upstream passage. Unscreened diversions under the influence of Aitken Ranch Dam were not directly observed, but simple rotating drum screens meeting anadromous fish screening criteria (3/32 in clear space screens sized to achieve < 0.4 fps approach velocity with internal porosity control) would likely be appropriate for pumped diversions. Gravity diversions, if any are present in this area, should be assessed for screening feasibility; vertical flat plate screens meeting the above criteria and with automatic wiper systems for cleaning would likely be the best approach if screens are deemed necessary.

(f) **Recommendation:** Do nothing for upstream passage. Assess unscreened diversions and seasonal stream temperatures, perhaps in conjunction with fish surveys to establish juvenile anadromous fish presence during the irrigation season, to determine if screens are needed.

- **Moore Dam**

(a) **Location:** Moore Dam is located on Auburn Ravine just upstream of Moore Road.

(b) **General Description:** Moore Dam is a seasonal flashboard dam on a somewhat modified reach of Auburn Ravine on the valley floor. A relatively wide expanse of semi-natural channel and riparian corridor extends upstream of the dam structure. The rectangular abutments are 56 ft apart and are joined by a concrete slab on the channel invert. Moore Dam is operated annually from 15 April to 15 October. A major water turnout is located in an alcove off the main Auburn Ravine channel about 70 ft to the

right of the right abutment, and is controlled by twin knife gates on two 36 in diameter culverts passing under an access road to a canal.

(c) **Assessment:** The seasonal operation of Moore Dam means that it is not a significant impediment to upstream-migrating anadromous fishes in most years. This reach of Auburn Ravine has physical habitat features which could support rearing juvenile anadromous fish, and temperatures in this part of the valley floor during at least part of the irrigation season would also support populations of these fish in some years. The diversion located in the immediate vicinity of this structure is unscreened, and may be a candidate for screening, along with others in this general area. The appropriateness for screening should depend on future investigations and temperature data review to see if they indicate that there is a significant risk to rearing anadromous fish populations in the general vicinity during the irrigation season.

(d) **Priority:** Low for passage. Medium for unscreened diversions in this reach (pending results of temperature data review).

(e) **Alternative Approaches:** If screening is deemed appropriate, simple rotating drum screens meeting anadromous fish screening criteria (3/32 in clear space screens sized to achieve < 0.5 fps approach velocity with internal porosity control) would likely be appropriate for pumped diversions. Gravity diversions, such as the turnout in direct association with Moore Dam, should probably be fitted with vertical flat plate screens meeting the above criteria and with automatic wiper systems for cleaning would likely be the best approach. In this case, the screen should be placed diagonally across the alcove with the downstream end on the left (looking in the direction of water flow. At that point, a 6 in diameter bypass pipe should be buried under the ground separating the right dam abutment from the alcove, with the bypass terminus in the scour pool below the dam.

(f) **Recommendation:** No upstream passage improvements are needed. Assess unscreened diversions and seasonal stream temperatures, perhaps in conjunction with fish surveys to establish juvenile anadromous fish presence during the irrigation season, to determine if screens are needed.

- **Nelson Lane Dam**

(a) **Location:** Nelson Lane Dam is located on Auburn Ravine approximately $\frac{1}{4}$ mile downstream of Nelson Lane near the Lincoln Airport.

(b) **General Description:** Nelson Lane Dam is a seasonal flashboard dam on Auburn Ravine in the lower elevation foothills above the valley floor. The trapezoidal abutments are 60 ft apart and are joined by a declining concrete slab on the channel invert. Nelson Lane Dam is operated annually from 15 April to 15 October in most years. A major pumped water diversion is located at the end of a long alcove off the main Auburn Ravine channel about 120 ft to the right of the right abutment. Four operating unscreened pumps are present with 8-10 inch diameter pipes extending into the alcove pool.

(c) **Assessment:** The seasonal operation of Nelson Lane Dam means that it is not a significant impediment to upstream-migrating anadromous fishes except at lower stream flows which may characterize portions of the migration period in some years. The tipped slab between the abutments creates a high-velocity area (super-critical flow) at lower discharge. This forces the water to become significantly shallower at this point and could create a significant impediment if lower stream flows persist. The water temperatures in this part of the Auburn Ravine watershed could support populations of rearing salmonid juveniles for at least portions of the irrigation season, making these fish vulnerable to entrainment by unscreened pumps associated with this facility. The location of the pumps at the end of an alcove with significant channel length means that if fish are actively migrating, they may enter a dead-end channel with downstream cues, leading to potentially significant migration delay.

(d) **Priority for Attention:** For upstream passage, medium. For pump screening, medium (pending review of temperature data and risk analysis).

(e) **Alternative Approaches:**

Upstream Passage – Pending discharge frequency data review and needs analysis, rock-bolt 10 x 10 inch treated timbers across the tipped concrete apron immediately downstream or immediately upstream of the flashboard channel supports, leaving a 1.5 - 2 ft wide gap in the middle of the span. This will form an attraction jet and concentrate flow into a deeper pattern, enabling passage at lower discharges. Clear out some of the rock debris in the pool immediately downstream of the concrete sill, as necessary.

Pump Screens – Pending water temperature data review and risk assessment, install vertical, rotating drum screens on each of the four pumps. Install a treated lumber wing-wall across the alcove near the pumps, leaving a gap of 3-4 ft between the end of the wall and the right alcove bank. This will force water flowing toward the pumps to approach from the right side of the pump line and pass along the line toward the left alcove bank. Install a 6 in diameter bypass pipe leading from the left alcove bank through the ground separating the alcove from the main Auburn Ravine channel, terminating below the sloping concrete sill between the dam abutments. Excavate a pool at the end of the pipe and submerge the outlet to kill the jet. This arrangement will create a sweeping flow along the row of pumps toward the bypass pipe and provide a downstream migration cue guiding fish to the bypass. It will only be necessary to operate the bypass during the downstream migration period.

(f) **Recommendation:** Perform need (upstream passage) and risk (pump screening) analyses. If improvements are indicated by the analyses, implement the alternatives described above.

- **Lincoln Ranch Duck Club Dam**

(a) **Location:** Lincoln Ranch Duck Club Dam is located approximately one mile upstream of the Brewer Road crossing.

(b) **General Description:** Lincoln Ranch Duck Club Dam is a seasonal flashboard dam on a highly modified reach of Auburn Ravine on the valley floor. The rectangular abutments are 27 ft apart and connected by a concrete sill. The abutments are spanned by a flatcar bridge. A gravity water turnout is located on the right bank of Auburn Ravine immediately upstream of the right dam abutment. A pumped diversion fitted with a trash screen is set into the left bank of Auburn Ravine immediately upstream of the left dam abutment. Lincoln Ranch Duck Club Dam is unusual in that it is operated into late November (1998 data), well into the upstream migration season for adult salmonids.

[Note: recent information indicates that this situation has been resolved, but the information is anecdotal and should be confirmed by discussions with the landowner and/or ranch manager.]

(c) **Assessment:** The unusual seasonal operation of this facility makes it a special case when assessing potential effects on upstream migration of anadromous fishes. The water surface elevation difference with flashboards in can be as much as 6 ft, depending on total stream flow. During higher flows, steelhead and chinook salmon can obviously negotiate this structure, since these species are known to reproduce at higher elevations in the watershed. However, this facility undoubtedly forms a significant impediment to upstream-migrating salmon and steelhead for a significant early part of the migration season. For this reason, passage improvements are desirable. The extended use of the associated pumped water diversion also poses some risk of entrainment of juvenile salmonids, especially small fry during initial dispersal following emergence from incubation. Although anadromous fish spawning is not thought to occur in the immediate vicinity of Lincoln Ranch Duck Club Dam, initial dispersal often transports fry considerable distances downstream. For this reason, screening this diversion, at least on a seasonal basis is considered desirable. A more complete evaluation, possibly incorporating sampling for fry presence during periods of operation, should be conducted prior to allocating significant expenditures for fish screens at this site, however.

(d) **Priority for Attention:** For upstream passage, medium to high, depending on water conditions during the upstream migration season. For diversion screening, low to medium, depending on a more thorough evaluation of seasonal entrainment risk.

(e) **Alternative Approaches:**

Upstream Fish Passage – This site is not well suited for a formal fishway bypassing the flashboard structure.

Pool excavation; pump extension -- This approach would involve excavating a pool or sump immediately upstream of the existing flashboard dam structure at the location of the diversion pump, and extending the pump tube into the sump. This would allow continued operation of the flashboards in the present manner, posing no change in upstream flood risk. The sump would have a tendency to accumulate fine sediment, however, potentially interfering with pump operation or increasing mechanical wear and maintenance costs. This might be successfully offset by installation of “vortex weirs” at the entrance to the

sump, which are designed to capture and concentrate bed load and “saltating” fine sediments and send them downstream. Some increase in energy costs would be incurred due to increased lift requirements.

Pool and chute fishway -- This approach would involve replacement of the existing flashboard dam structure with a formal “pool-and-chute” fishway section across the entire Auburn Ravine channel. This structure would permanently raise the invert elevation of the Auburn Ravine channel at this point, increasing the risk of flooding upstream in the event of very high discharge (no flashboard adjustment would be possible). The pool behind the structure would have a tendency to fill with fine sediment, potentially interfering with pump operation or increasing mechanical wear and maintenance costs. No increased energy cost would be incurred, however.

Screening – Pending an entrainment risk analysis demonstrating need, the diversion pump could be fitted with a vertical drum screen meeting appropriate fish screen criteria (3/32 in clear space screens sized to achieve 0.4 fps approach velocity with internal porosity control). A hydraulic analysis of the expected flow net in the immediate vicinity of the screen should be performed to determine whether a simple rotating screen or a back-flush or wiper system would be most appropriate for screen cleaning.

(f) **Recommendation:** For upstream-migrating anadromous fish passage, implement the first alternative described above. Analyze the appropriateness of use of “vortex weirs” and develop a maintenance schedule accordingly. Perform an entrainment risk analysis, and install a drum screen if indicated by the analysis.

- **NID Diversion (Hemphill Dam)**

(a) **Location:** Hemphill Dam is located on Auburn Ravine upstream of the City of Lincoln, adjacent to the Turkey Creek Golf Course.

(b) **General Description:** Hemphill Dam is a relatively large seasonal flashboard dam on a slightly modified reach of Auburn Ravine in the low elevation foothills of the watershed near the Turkey Creek Golf Course. The trapezoidal dam abutments are about 8 ft high and 64 ft apart, connected by an elevated horizontal concrete sill. A relatively smooth gunnited rubble apron slopes downstream from the concrete sill to a plunge pool filled with large angular boulders for energy dissipation. Banks upstream and downstream of the abutments are about 75 ft apart and are protected by large gunnited rip-rap. This bank protection is more prominent on the right bank, extending about 75 ft upstream and 60 ft downstream of the abutments. An unscreened gravity diversion with a knife gate control and a sloping trash rack is located on the left bank about 50 ft upstream of the left dam abutment. The elevation of the sill between the dam abutments is about 6 ft above the natural invert of the stream channel, and the relatively smooth gunnited rubble apron produces very shallow super-critical sheeting flow at low to moderate stream flows.

(c) **Assessment:** At most stream flows, including flows representative of those occurring during the adult anadromous fish migration season, the configuration of the sill and apron at Hemphill Dam produces super-critical flow for a distance of at least 30 ft. This results in a velocity barrier condition for upstream-migrating anadromous fish at all but very high stream flows when the entire structure becomes drowned out and swim-over conditions would be present. The relatively greater bed roughness on the apron near the right abutment may ameliorate this condition somewhat, reducing passage difficulties at moderately high stream flows, but this structure would still probably be considered an impediment, potentially resulting in migration delays or “encouraging” fish to spawn further downstream than would otherwise be the case. It should be noted that there is some very good spawning habitat for chinook salmon, and possibly steelhead, in the reach downstream of Hemphill Dam. The gravity diversion is unscreened, and would present a threat of entrainment of juvenile salmonids present during periods of operation. Since this facility is in the low elevation foothills of the Auburn Ravine foothills, water temperatures would likely support rearing populations of juvenile salmonids during part of the irrigation season. In addition, as noted above, relatively good spawning habitat is present in the general vicinity of Hemphill Dam, suggesting that populations of rearing anadromous fish may well be present during portions of the irrigation season in at least some years. This suggests that screening the diversion in association with Hemphill Dam, and others in the general vicinity is appropriate.

(d) **Priority for Attention:** For upstream anadromous fish passage, high. For diversion screening, medium to high, depending on results of a risk assessment (perhaps including sampling for rearing anadromous fish presence during portions of the irrigation season).

(e) **Alternative Approaches:**

Upstream Fish Passage – Upstream fish passage at this site could be provided in two ways.

Pool and chute fishway -- This site is very conducive to installation of a pool and chute fishway spanning the entire Auburn Ravine channel. This structure would replace the existing gunnited rubble apron immediately downstream of the horizontal concrete sill connecting the dam abutments. Little or no change in channel conveyance capacity is anticipated for this approach. If detailed hydraulic analysis indicates that channel conveyance capacity would be reduced, it is expected that this change would be minor and could be mitigated by a slight increase in channel width at the dam site, which could be accomplished by moving one of the abutments back an appropriate distance. This approach would assure good passage conditions at all migration season discharges when the dam is in its flashboards-out condition. Advantages of this approach include essentially maintenance-free operation, good to excellent passage conditions under all or nearly all flow conditions, no migration delay and limited or no poaching/vandalism opportunities. Disadvantages include potential for slight decrease channel conveyance capacity and possibly relative cost.

Backwater the apron and add roughness -- This approach is similar to the pool and chute fishway described in the first alternative, above, but less formal in execution, with a less reliable outcome. Backwatering of the Hemphill Dam apron would involve construction of a series (probably three) of low, shallow “V” weirs, with each consecutive “V” 12-18 in higher in elevation than the one downstream. The furthest upstream “V” should be located near the toe of the existing apron. Roughness elements (“dentates”) should be added to the apron near the crest to break up sheeting flow and provide hydraulic complexity. Advantages of this approach include good passage conditions over a wide range of stream flows while the dam is in the flashboards-out configuration, essentially maintenance-free operation, no significant migration delay, limited poaching/vandalism opportunities, and potential cost savings over the first alternative. Disadvantages include a larger construction footprint than the first alternative and a slightly increased potential for reducing overall channel conveyance capacity at the crest of the apron in the flashboards-out configuration. This last disadvantage could be overcome by moving one of the abutments back an appropriate distance, if deemed necessary.

Formal slotted fishway -- This approach would involve design and construction of a formal fishway around Hemphill Dam. Adequate space exists on either side of the dam, but each side has advantages and disadvantages. Advantages of the right side include lower poaching and vandalism opportunities. Disadvantages of the right side include more difficult construction and maintenance access, probably involving right-of-way acquisition. Advantages of the left side include easy construction and maintenance access and probably little or no difficulty obtaining a right of way or easement. Disadvantages include increased poaching and vandalism risk and an alignment conflict with the existing diversion canal, requiring an inverted siphon in the canal under the fishway alignment. Other advantages of this general approach include potentially lower cost and no risk of reduction of channel conveyance capacity. Other disadvantages of this general approach include a narrower range of ideal operating conditions relative to Auburn Ravine stream flow, increased overall risk of vandalism and poaching, and regular maintenance requirements.

Screening – If screening the gravity diversion is warranted by an entrainment risk analysis, the most appropriate approach for this site is a vertical flat plate screen meeting appropriate anadromous fish screening criteria (3/32 in clear space screen; 0.4 fps approach velocity) constructed flush with the left bank in the approximate location of the existing diversion. The screen should have a mechanical wiper for cleaning which could be driven mechanically or by hydraulic motor off a paddle wheel in the diversion canal. If water depth is insufficient to achieve necessary screen area without excessive length, the screen panel could be sloped, but the slope should not be flatter than 45E off the vertical with a mechanical wiper cleaning device. If the screen is flatter than 45E, an air burst cleaning system should be considered, but this would require pulling power to the site and installing a compressor and pressure accumulator tank, along with appropriate controls and sensors. The mechanical wiper system is by far the simpler system, and would require less maintenance and a lower capital outlay.

(f) **Recommendations:** For adult fish passage, implement the pool-and-chute fishway alternative on a high-priority basis, pending results of a uniform engineering cost estimate (if such a cost estimate favors the backwatering/roughness approach, implement that alternative instead). For screening, assuming an entrainment risk assessment indicates the need for screens, implement the described approach.

- **Ophir Tunnel Cataract**

(a) **Location:** The cataract at Ophir Tunnel is located just upstream of Lozanos Road on Auburn Ravine

(b) **General Description:** A steep cataract is located on Auburn Ravine immediately adjacent to the outlet of Ophir Tunnel. The flows over the cataract exhibit much hydraulic complexity passing over a very rough bed, except at the lower end, where the rock is smoother.

(c) **Assessment:** This cataract is clearly an impediment to steelhead at lower stream flows, but is probably passable to some fish at high stream flows. Because of the smoother bed and reduced hydraulic complexity at the lower end, this part of the cataract is the more difficult part for fish to negotiate. Some improvement in passage conditions over a wider range of flows could be achieved by backwatering the lower end of this cataract, giving fish an opportunity to reach more complex portions of this area with less effort and fewer trials.

(d) **Priority for Attention:** Medium.

(e) **Alternative Approaches:** The most cost effective approach to improving steelhead passage conditions at this impediment is to backwater the lower end of the cataract with a series of two or three low, shallow “V” weirs installed across the plunge pool immediately downstream. Crest elevations of these weirs should be 12 to 18 in apart; the weirs themselves should be about 10 ft apart, with the most upstream in the series about 10-12 ft downstream of the existing toe of the cataract.

(f) **Recommendation:** Implement the approach described above on a medium priority basis.

- **Nevada Irrigation District Auburn Ravine 1 Dam**

(a) **Location:** Nevada Irrigation District (NID) 1 Dam is located on Auburn Ravine off Chili Hill Road.

(b) **General Description:** NID 1 Dam is a gravity arch dam in the middle of the Auburn Ravine watershed. The level crest of the dam is about 8 ft above the tailwater during normal stream flows. The pool behind the dam feeds an unscreened gravity diversion to the NID ditch on the north side of Auburn Ravine. The ditch is lined with gunnite for most of its length in this area. A sluice gate for flushing sediment, which

accumulates behind the dam, is located on the north side of the crest near the entry to the ditch. Channel depth below the dam is deeper on the south side, with boulders and bedrock protruding from the tailwater on the north side during normal stream flows.

(c) **Assessment:** This dam is clearly a migration barrier to upstream-migrating salmon and steelhead except at high stream flows approaching drown-out, when it would become an impediment. The level crest distributes overflow evenly. Greater channel depth on the south side of the channel opposite the ditch would tend to encourage fish to congregate in that area under most flow conditions, making an accessible solution more difficult. A formal fishway on the south side of the dam is probably not feasible, due to severe access difficulties. Protruding bedrock formations on the north side of the channel below the dam add difficulty to a passage solution in that area. Presence and operation of the sediment sluice next to the ditch add complexity to a passage solution on the north side of the dam. Much of the best steelhead habitat in the Auburn Ravine watershed is located upstream of this facility, increasing the importance of a passage solution here. This part of the Auburn Ravine watershed contains excellent anadromous fish rearing habitat and water quality. Since juvenile anadromous fish are present in this area on a year-round basis, screening the approximately 100 cfs diversion is important.

(d) **Priority for Attention:** For upstream passage: high; for diversion screening: high.

(e) **Alternative Approaches:** Any passage solution on the south side of NID 1 Dam is plagued with virtually impossible access problems, effectively eliminating this area from consideration. Stepping up the stream channel below the dam would severely reduce channel conveyance capacity immediately below the dam, threatening the ditch and control works during high stream flows, effectively eliminating this approach as a viable solution candidate. The only remaining approach is to construct a formal fishway on the north side of the dam, in association with the canal, in spite of the presence and operation of the sediment sluice system in this area and protruding bedrock on this side of the channel immediately downstream of the dam. An integrated adult fishway and screen/bypass system is probably feasible. This approach would involve removing some of the bedrock outcrop on the north side of the channel (without threatening ditch or dam integrity) and constructing a slotted fishway structure on the south side of the existing ditch, possibly using remaining bedrock as foundation. The entry (downstream end) of the fishway should have multiple entry ports to provide entry “choices” under a variety of hydraulic conditions. Supplemental attraction flow in the form of a jet angled obliquely across the deeper water channel on the south side of the channel may improve fishway performance, and should be considered. The exit (upstream end) of the fishway should be into the existing canal. It should be located far enough downstream to serve as the juvenile bypass for a diagonal vertical flat plate screen meeting anadromous fish screen criteria (3/23 in clear space screen; 0.4 fps approach velocity). Assuming 4 ft submergence, gross screen area requirements for an assumed 100 cfs ditch capacity and some room for civil works and screen cleaning system mechanical systems; the fish screen structure would probably occupy 70-75 ft of channel length. Since the fishway slope would probably be about 1:10 - 1:15, this location could allow sufficient distance to

achieve necessary elevation gain. The screen wiper system for cleaning could be activated by pulling power to the site or by using a paddle wheel in the canal. Head loss associated with this system could probably be held to about 6 in if the screen is kept relatively clean. Under normal operating conditions, judging from water stains along the canal sufficient head is available. Some freeboard on the outer ditch wall may be necessary in the immediate vicinity of the screen system. It is possible that adult anadromous fish will have difficulty finding the fishway entry under some stream flows even with a supplemental attraction flow jet. If this proves to be the case, thought should be given to adding a very gradually sloping crest to the arch dam, with the crest about 4-6 in higher on the south side. This will gradually concentrate overflow moving along the crest, tending to pull fish to the north side of the channel, in spite of greater channel depth on the south side. This feature should only be added if deemed necessary through performance monitoring.

(f) **Recommendation:** Implement the described approach on a high priority basis.

2. Water Flows

Fall and winter water flows are particularly important in Auburn Ravine. Because water deliveries are curtailed, generally before fall-run chinook salmon attempt to migrate upstream to spawn, the depth of water in the channel can be insufficient to provide adult passage. Adult chinook salmon and steelhead need approximately 1± foot of water depth with some resting pools in order to migrate upstream. Transit time for adult fish from the Cross Canal confluence to upstream of Highway 65 could routinely be accomplished in one to two days. However, adequate water depth is critical and should be taken into consideration concurrently with any fish passage projects for this drainage. Until water temperatures became too warm to allow safe entry into Auburn Ravine, flows downstream of diversion dams in the spring would be needed to pass half-pounder steelhead and allow migration into upstream areas. Another potential problem that has not been adequately addressed is the attraction of adult salmonids to the new discharge location of the new Lincoln wastewater treatment facility. While fish may be prevented from entering the discharge, the volume of water potentially discharged will be enough to provide routine fall/early winter passage for adult salmonids. However, once adult fish reach the location of the discharge, they potentially face a stream channel with little or no flow for miles. The area in which the discharge is located is not suitable for anadromous fish spawning.

3. Beaver Dams

Beaver dams and beaver activity in general are a major impediment to adult anadromous fish passage in this watershed. During the stream videography project, five major beaver dams were documented between the confluence with Eastside Canal and the Goldhill Road crossing on March 12, 2003. In addition two major beaver dams were located in the City of Lincoln approximately ½ mile downstream of Highway 65 and within the NID gaging station about a ¼ mile downstream of Highway 65. The dam in the NID gage was 4 feet tall and combined with the 4 foot drop at the downstream end of the structure, with no jumping pool, this situation was a barrier throughout the winter of 2002-2003.

APPENDIX AUBURN RAVINE 1

HEAVY METALS COMPARISON BETWEEN AUBURN RAVINE AND EASTSIDE CANAL

	Assumes a Hardness of 50 mg/l as CaCO3	Maximum Concentration (Acute) (mg/l)	Continuous Concentration (Chronic) (mg/l)			
	METAL					
	Barium	No standard	No standard			
	Cadmium	0.002	0.0013			
	Copper	0.007	0.005			
	Zinc	0.067	0.066			
Stream	Location	Date	Cadmium mg/l	Copper mg/l*	Zinc mg/l	Notes
Auburn Ravine	Sutter County	01/25/01	0.000020	0.00381	0.00436	Hardness = 55 mg/l
Auburn Ravine	Sutter County	03/01/01	0.000024	0.00571	0.00482	Hardness = 70 mg/l
Auburn Ravine	Sutter County	04/05/01	0.000009	0.00201	0.00249	Hardness = 36 mg/l
Auburn Ravine	Sutter County	05/03/01	0.000006	0.00179	0.00111	Hardness = 36 mg/l
Auburn Ravine	Sutter County	06/06/01	0.000008	0.00247	0.00113	Hardness = 27 mg/l
Auburn Ravine	Sutter County	07/17/01	0.000018	0.00297	0.00388	Hardness = 27 mg/l
Auburn Ravine	Sutter County	08/02/01	0.000008	0.00177	0.00151	Hardness = 29 mg/l
Auburn Ravine	Sutter County	09/06/01	0.000006	0.00188	0.00088	Hardness = 25 mg/l
Auburn Ravine	Sutter County	10/11/01	0.000010	0.00293	0.00200	Hardness = 43 mg/l
Auburn Ravine	Sutter County	10/31/01	0.000038	0.00525	0.00624	Hardness = 59 mg/l
Auburn Ravine	Sutter County	12/21/01	0.000146	0.01970	0.02900	Hardness = 46 mg/l
Cross Canal	Sutter County	01/25/01	0.000039	0.00445	0.00555	Hardness = 65 mg/l
Cross Canal	Sutter County	03/01/01	0.000052	0.01100	0.0102	Hardness = 72 mg/l
Cross Canal	Sutter County	04/05/01	0.000014	0.00299	0.00301	Hardness = 46 mg/l
Cross Canal	Sutter County	05/03/01	0.000015	0.00298	0.0019	Hardness = 46 mg/l
Cross Canal	Sutter County	06/06/01	0.000023	0.00214	0.00113	Hardness = 52 mg/l
Cross Canal	Sutter County	07/17/01	No Flow	No Flow	No Flow	No Flow
Cross Canal	Sutter County	08/02/01	0.000015	0.00278	0.00291	Hardness = 59 mg/l
Cross Canal	Sutter County	09/06/01	0.000014	0.00302	0.0026	Hardness = 70 mg/l
Cross Canal	Sutter County	10/11/01	0.000013	0.00343	0.00236	Hardness = 65 mg/l
Cross Canal	Sutter County	10/31/01	0.000015	0.00354	0.00228	Hardness = 63 mg/l

Cross Canal	Sutter County	12/21/01	0.000098	0.0117	0.0158	Hardness = 58 mg/l
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* Values in bold exceed California Toxics Rule objectives for aquatic life at a hardness of 50 mg/l.

Sources: California Toxics Rule (water quality objectives); Department of Water Resources unpublished data.

APPENDIX AUBURN RAVINE 2

Auburn Ravine Selected Water Quality Monitoring Data Near the City of Auburn's Wastewater Treatment Plant 1995 Monitoring Results

1995 Monitoring Results for Selected Parameters from Auburn Ravine. Location R-1 is just upstream of the City of Auburn's Wastewater Treatment Plant Discharge. Location R-4 is Downstream of the Discharge in the Mixing Zone.

Parameter	Location	Frequency	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Dissolved Oxygen	R-1	Mean Monthly	mg/l	11.1	12.1	9.8	11.3	11.1	11.4	10.9	10.6	9.8	10	10.7	11.7
	R-4	Single Sample	mg/l	11.09				10.5				9.78	9.25		
Temperature	R-1	Mean Monthly	°C	8.7	6.4	7.5	9	9.8	11	12.3	14.3	15.9	14.56	11.9	10.1
	R-4	Single Sample	°C	8.6				13				17.9	18.3		
pH	R-1	Mean Monthly	units	7.4	7.2	5.7	7.3	7.3	7.2	7	7.1	7	7.4	7.2	7.3
	R-4	Single Sample	units	9.4				6.6				7.14	7.73		
Nitrate	R-1	Mean Monthly	mg/l	2				<0.50				<0.50	3.6		
	R-4	Single Sample	mg/l	3				<0.50				1.8	3.7		
Total Phosphorus	R-1	Mean Monthly	mg/l	<0.05				<0.02				<0.02	0.04		
	R-4	Single Sample	mg/l	0.08				0.09				0.19	0.51		
Hardness	R-1	Mean Monthly	mg/l	36				23				20	61		
	R-4	Single Sample	mg/l	43				24				14	71		

Source: FEIR for the Auburn Wastewater Facility Plan, 1997; Adapted from Table 3-9.

APPENDIX AUBURN RAVINE 3

BENTHIC MACROINVERTEBRATE DATA COLLECTED BY THE AUBURN RAVINE CITIZENS GROUP

[illegible]

			Limnophila												
			Planorbidae	6	sc									1	
			Bivalvia												
			Pelecypoda												
			Corbiculacea	10	cf								1		
NEMATODA				5	p										
NEMERTEA															
PLATYHELMINTHES															
			Turbellaria												
			Tricladida												
			Planariidae	4	p										
ANNELIDA															
			Oligochaeta	5	cg				1		2	11	5	5	
			Total Macroinvertebrates:			37	4	100	5	72	54	33	82	82	96
¹ TV: Tolerance Values															
² FFG: Functional Feeding Groups															
			Taxonomic Richness			4	2	6	2	7	7	7	12	12	8
			EPT Taxa			2	1	3	1	4	5	4	5	5	2
			Ephemeroptera Taxa			0	0	2	0	1	2	2	2	2	2
			Plecoptera Taxa			1	1	1	1	2	2	1	1	1	0
			Trichoptera Taxa			1	0	0	0	1	1	1	2	2	0
			EPT Index			8	50	11	40	22	65	82	30	39	46
			Sensitive EPT Index			8	50	4	40	11	56	70	2	6	0
			Tolerance Value			5.6	3.5	5.7	4.0	5.2	3.1	2.2	5.3	4.9	5.0
			Percent Intolerant Organisms			8	50	4	40	11	56	70	2	6	0
			Percent Tolerant Organisms			2.7	0.0	0.0	0.0	0.0	0.0	0.0	3.7	0.0	1.0
			Percent Dominant Taxon			89	50	85	60	75	37	67	24	45	42
			Percent Collectors			89	50	92	60	86	43	27	63	80	91
			Percent Filterers			0	0	0	0	1	2	3	28	0	3
			Percent Grazers			3	0	0	0	0	0	0	0	4	0
			Percent Predators			8	50	8	40	13	56	70	9	11	6
			Percent Shredders			0	0	0	0	0	0	0	0	0	0
			Other			0	0	0	0	0	0	0	0	5	0
						03/01/00		03/01/00		09/01/01					
						Auburn Ravine		Auburn Ravine @		Auburn Ravine @					

						@								
						Joiner Parkway *		Moore Road		Joiner Parkway				
						Mean	SE	CST	Mean	SE	CST	Mean	SE	CST
					Taxonomic Richness	4	1.0	8	7	0.0	8	11	1.3	17
					EPT Taxa	2	0.5	4	4	0.3	5	4	1.0	7
					Ephemeroptera Taxa	1	0.5	2	2	0.3	2	2	0.0	2
					Plecoptera Taxa	1	0.0	1	2	0.3	2	1	0.3	1
					Trichoptera Taxa	0	0.3	1	1	0.0	1	1	0.7	4
					EPT Index (%)	27	10	12	56	18	49	38	4.4	39
					Sensitive EPT Index (%)	26	11	8	45	18	38	3	1.8	3
					Dominant Taxon (%)	71	9.5	84	60	12	47	37	6.4	35
					Tolerance Value	4.7	0.6	5.5	3.5	0.9	3.9	5.0	0.1	5.0
					Intolerant Organisms (%)	26	11	8	45	18	38	3	1.8	3
					Tolerant Organisms (%)	0.7	0.7	0.7	0.0	0.0	0.0	1.6	1.1	1.5
					Collectors (%)	73	10	89	52	18	59	78	7.9	79
					Filterers (%)	0	0.0	0	2	0.5	2	10	8.9	10
					Grazers (%)	1	0.7	1	0	0.0	0	1	1.2	1
					Predators (%)	27	11	10	46	17	39	9	1.4	8
					Shredders (%)	0	0.0	0	0	0.0	0	0	0.0	0
					Other (%)	0	0.0	0	0	0.0	0	2	1.6	2
					* Site statistics based on small and variable sample sizes									

BEAR RIVER

A. Water Quality Data

No data are currently available. A report prepared for the South Sutter Water District may contain water quality information. The report may be available for public distribution in late-December 2003.

B. Water Temperature Data

- Water Temperature Information from Bailey Environmental Late-May 2003 to August 2003:** Bailey Environmental began a water temperature monitoring program for Placer County beginning in May 2003. The early results from this sampling program are presented in Figures 1 and 2 below. Figure 1 displays data from a site located at the upstream boundary of the Patterson Sand and Gravel operation, approximately 2,000 feet downstream of the South Sutter irrigation diversion dam below Camp Far West Reservoir. Figure 2 displays data from a site located at the downstream boundary of the Patterson Sand and Gravel operation. **Source: Bailey Environmental, unpublished data.**

Figure 1. Water temperature time series from the upper Patterson Sand and Gravel site on the Bear River for the period May 28 to August 4, 2003. Conditions appear to be suitable for juvenile rearing.

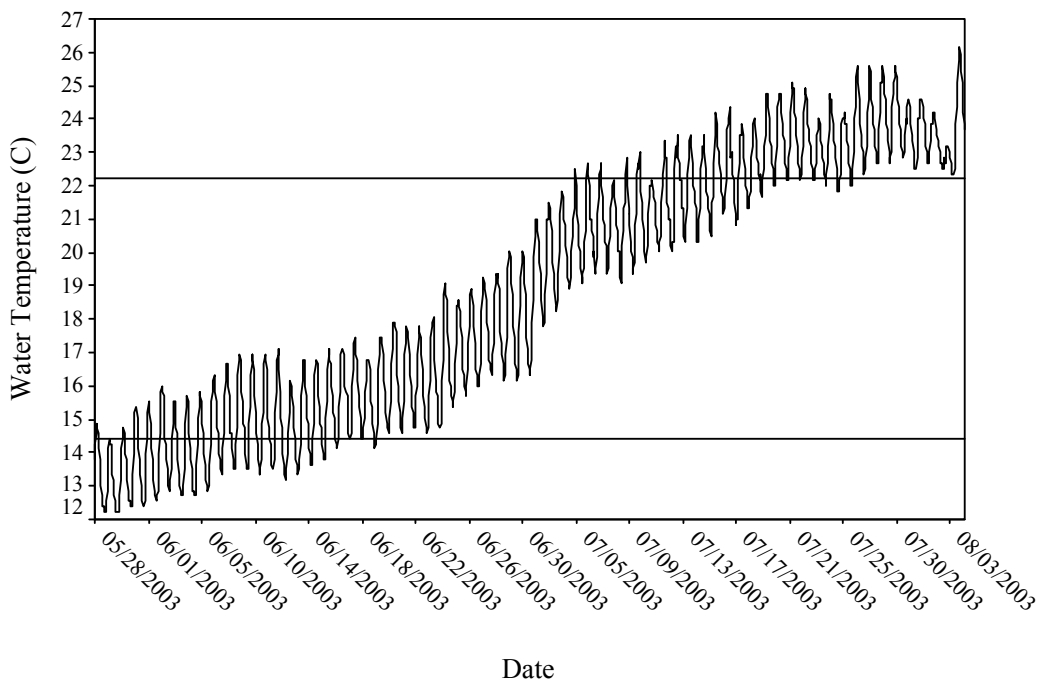
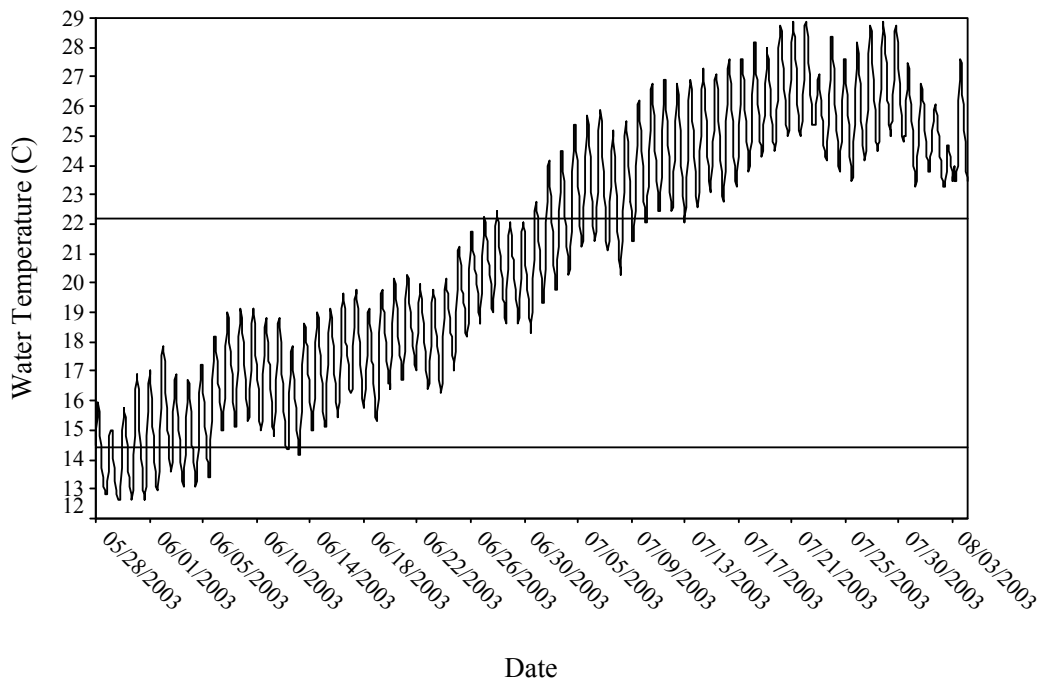


Figure 2. Water temperature time series from the lower Patterson Sand and Gravel site on the Bear River for the period May 28 to August 4, 2003. Conditions do not appear to be suitable for juvenile rearing.



C. Benthic Invertebrate Data

No data are currently available. A report prepared for the South Sutter Water District may contain water quality information. The report may be available for public distribution in late-December 2003.

D. Physical Habitat Data

No data are currently available. A report prepared for the South Sutter Water District may contain physical habitat information. The report may be available for public distribution in late-December 2003.

E. Fishery Resource Data

While no fishery resource data is currently available, fall-run chinook salmon are present in the system and do spawn downstream of Camp Far West Reservoir. There is some anecdotal evidence of spawning but no reliable estimates of run size. A report prepared for the South Sutter Water District may contain fishery resource information. The report may be available for public distribution in late-December 2003.

F. Fish Passage or Screening Data

No data are currently available. A report prepared for the South Sutter Water District may contain fish passage or screening information. The report may be available for public distribution in late-December 2003.

COON CREEK

A. Water Quality Data

1. **Lincoln High School Water Quality Monitoring:** Mark Fowler and Lee Beckman provided the following water quality data from the Lincoln High School sampling program, which was jointly funded by NID, Placer County, and the City of Lincoln. While the data are limited, two parameters are of concern from a stream ecology standpoint. First, the dissolved oxygen concentrations reported show supersaturated levels of approximately 150%, which is unusual for lower gradient streams; these data may be unreliable due to methodological problems. Second, the concentrations of nitrate reported are high for a fall reading and could indicate eutrophication of the stream, particularly during the summer months. Without data on orthophosphate for comparison, it is impossible to determine if nitrates are limiting biostimulation of algal growth and potentially causing diurnal dissolved oxygen fluctuations during the nighttime hours. Excessive algal growth has been observed in Coon Creek during the summer at these locations. **Source: Lincoln High School Water Quality Monitoring, unpublished data.**

Table 1. Coon Creek water quality data 2002

Parameter	Tahti Property	Fleming Property
Date	10/6/2002	11/17/2002
Time	0955	1115
Air Temperature (°F)	--	61
Water Temperature (°F)	63	52
Weather	Clear	Clear
Stream Flow (cfs)	0.9	3.3
pH	7.35	7.3
Dissolved Oxygen (mg/l)	16.5	16.5
Electrical Conductivity (µs/cm)	97.4	166.5
Color (color units)	14	50
Nitrates (mg/l)	1.1	3.6
Chlorides (mg/l)	0.04	0.04
Total Coliform (MPN/100ml)	93	150
Fecal Coliform (MPN/100ml)	240	43

Source: Lincoln High School Water Quality Monitoring, unpublished data.

2. **Auburn Ravine/Coon Creek Ecosystem Restoration Plan:** This plan, published by the County of Placer, contains preliminary data on heavy metals and a number of other constituents. This data were collected on Auburn Ravine, Coon Creek, and in the Eastside Canal (the actual sampling location is actually just upstream of the Cross Canal, even though the data location is labeled Cross Canal). The County is already in possession of this data in electronic format and therefore it is not repeated here. However, the data for cadmium, copper, and zinc are presented in Appendix Coon Creek 1 because all of these metals at some times of the year exceed California Toxic Rule objectives for aquatic life. In Coon Creek, the only metal that exceeds the standards at 50 mg/l hardness is copper. The other metals are included because their standards

are exceeded in other streams in the western portion of the County. **Source: California Toxics Rule and Department of Water Resources unpublished data.**

3. FEIR Teichert Aggregate Facility: In the final EIR for this project, Table 13-2 displays surface water quality data for several sites that were sampled once in January 1994. The sites are labeled as W-4, W-5, W-7, and W-8 on Revised Figure 13-6 in the document and correspond to sites in the center of the project area, upstream of the project area but just downstream of Gladding Road, a site just upstream of Gladding Road on the south channel, and a site just upstream of Gladding Road on the north channel, respectively. In general, the water quality parameters measured fall within an expected and acceptable range for anadromous fish streams. However, some of the detection limits used in the analysis preclude an assessment of whether or not certain constituents meet the water quality standards established in the California Toxics Rule. Table 2 displays some pertinent constituents and the applicable standards. **Source: FEIR Teichert Aggregate Facility 2000, Placer County Planning Dept.**

Table 2. Selected water quality constituents from the Teichert Project Site and immediate upstream locations, based on a single sample in January 1994. California Toxic Rule standards are based on a hardness of 100 mg/l as CaCO₃. Hardness values less than 100 reduce the acceptable concentration of each applicable standard accordingly.

Constituent	Maximum Concentration (Acute) mg/l	Continuous Concentration (Chronic) mg/l	W-4 mg/l	W-5 mg/l	W-7 mg/l	W-8 mg/l
Hardness	--	--	88	88	85	100
pH			7.6	7.8	7.7	7.5
Silver	0.0034	--	<0.010	<0.010	<0.010	<0.010
Cadmium	0.0043	0.0022	<0.010	<0.010	<0.010	<0.010
Copper	0.0013	0.0090	<0.050	<0.050	<0.050	<0.050
Lead	0.065	0.0025	<0.010	<0.010	<0.010	<0.010

Source: FEIR Teichert Aggregate Facility; California Toxics Rule.

4. NPDES Monitoring Data from Placer County's Wastewater Treatment Plant (SMD #1): Placer County operates this treatment plant and discharges the effluent into Rock Creek immediately upstream of its confluence with Dry Creek. Dry Creek converges with Orr Creek a short distance downstream to become Coon Creek. Approximately 20 years of monitoring data are available. I have included some selected data, (collected in 2001) from the monitoring station designated as R-4, which is in the mixing zone downstream in Dry Creek, to illustrate several points. This source of flow has a definitive effect on the water quality of Coon Creek. While the NPDES monitoring requirements do not require measurement of nitrate levels, this discharge is a major contributor of nitrogen loading in the stream. Floating mats of algae and attached aquatic plants are evident many miles downstream from the discharge. Also, the pH data for the year 2001 (Figure 2) illustrates the rapid fluctuations in values that are being recorded in other streams in western Placer County. Finally, adult fish passage in Coon Creek is almost completely blocked by a barrier in the canyon area of the stream, upstream of Garden Bar Road and downstream of Bell Road. However, there is some anecdotal evidence from local residents, who have occasionally observed salmon and steelhead in Dry Creek. Review of the video taken of this section of the stream shows that the physical habitat conditions appear to be

suitable for salmon and steelhead spawning and rearing on at least an intermittent to annual basis if fish passage were provided over the waterfalls and cascades in the canyon area. Under high flow conditions, fish passage is probably suitable for some percentage of the population. The question is whether the water quality and water temperatures in this section are suitable to justify the investment in a passage program. Water temperature data is presented in the water temperature section of this report. **Source: NPDES Monitoring Data from Placer County's Wastewater Treatment Plant (SMD #1), unpublished data.**

Figure 1. Dissolved oxygen concentrations from NPDES monitoring station R-4, Dry Creek/Coon Creek, during 2001. These data show that dissolved oxygen levels are adequate to support anadromous fish spawning and rearing. The reference at 7 mg/l is considered a minimum optimum level, but salmonids will handle concentrations as low as 5 mg/l.

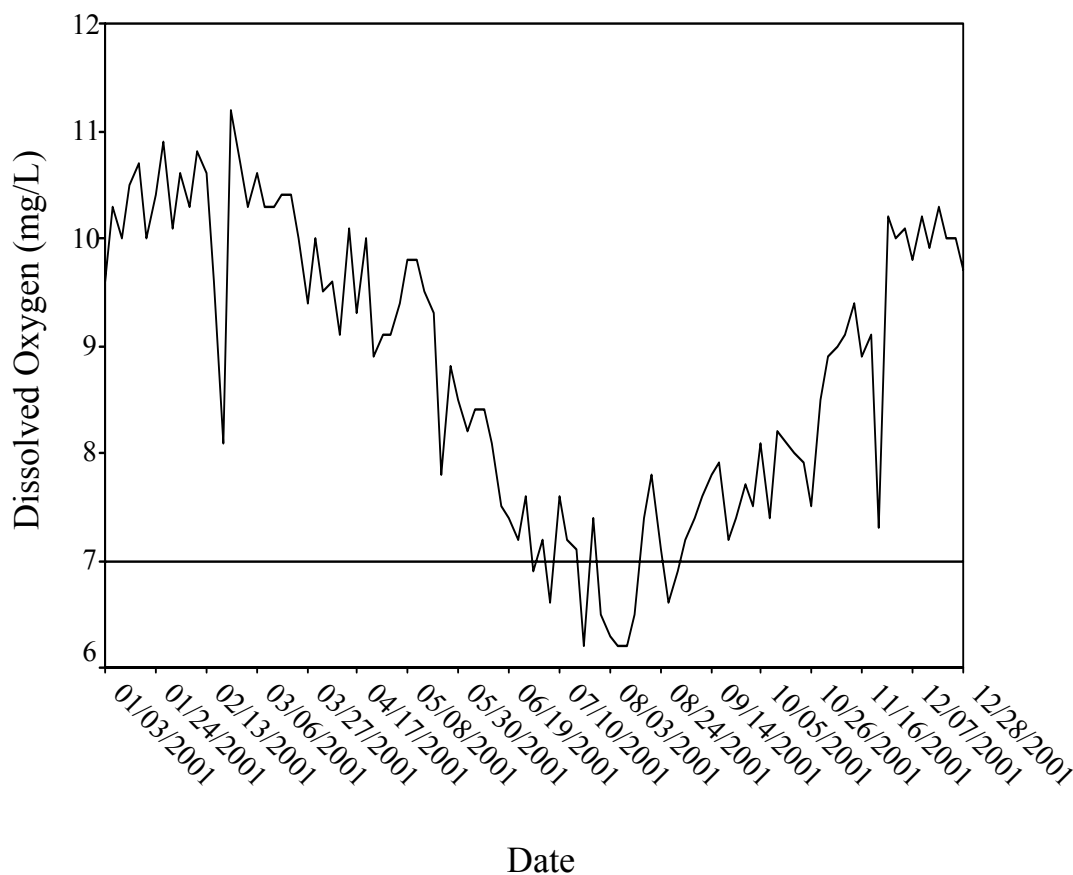
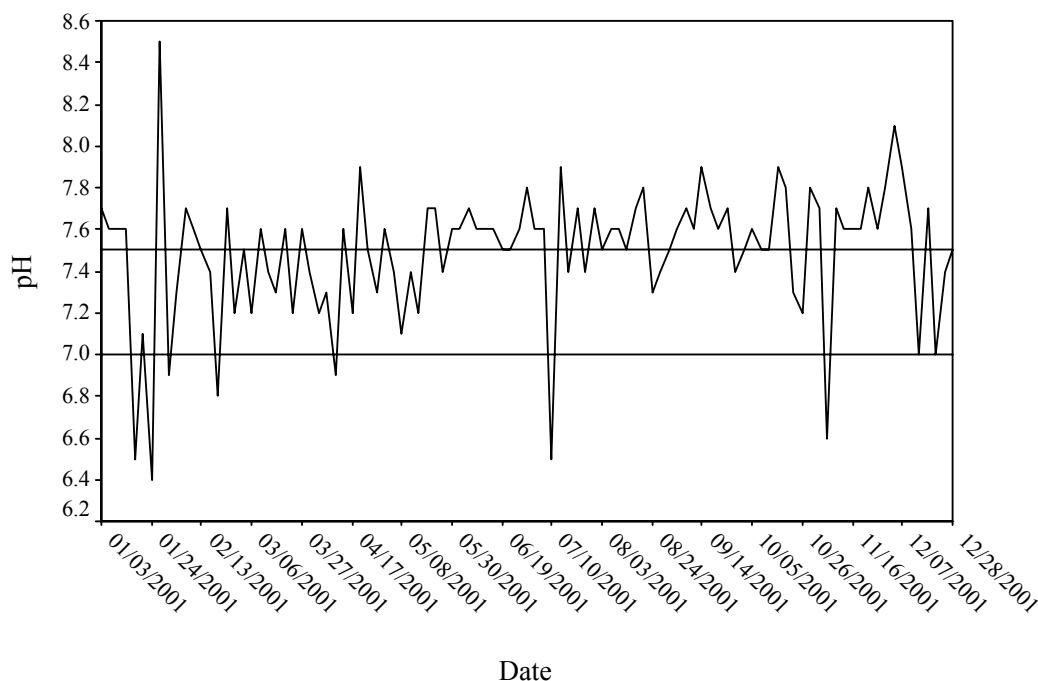


Figure 2. pH values from NPDES monitoring station R-4, Dry Creek/Coon Creek, during 2001. The rapid rate and magnitude of changes are unexplained at this time. Finding the cause the rate and magnitude of changes is essential before any decisions regarding fish passage over the canyon area obstacles are made.



B. Water Temperature Data

Water temperature data were extracted from various one-time fish sampling projects conducted by the CDFG and are presented below. Most of the available data comes from monitoring conducted by Bailey Environmental and includes hourly readings. Due to limitations in the statistical package, only 3,000 temperature data points can be displayed in a single time series plot. Since daily maximum, minimum, and/or mean temperatures individually are of little value, I have chosen to plot all data points. Therefore, I have split the year into time periods that roughly correspond to:

Fall-early winter: September through December; primary fall-run chinook spawning period is November-December.

Winter-spring: January through April; fall-run chinook incubation and rearing and steelhead spawning, incubation, and rearing.

Late spring-summer: May to September; summer rearing for steelhead juveniles.

Data plots for these time periods are presented below to allow the reader to assess the potential of Coon Creek to support chinook salmon and/or steelhead trout spawning and rearing. A variety of localized data and literature was reviewed, in order to get some generalized understanding of the temperature effects on various life history stages for both chinook salmon and steelhead trout. There is fairly substantial variation in temperature effects noted for most life history stages. However, both chinook salmon and steelhead are have a highly adaptable physiology and ability to seek thermal refuge during part of the day which allows them to tolerate and/or avoid

lethal temperatures. Some of the literature sources cite criteria reported by others and some of the data is based on fish captures with water temperature taken concurrently. Two tables with data and reference are included in Appendix A of this report. Based on this review, the following criteria have been used to indicate what life history stages a particular stream may support at any given time:

<u>Chinook Salmon</u>	<u>°C</u>	<u>Steelhead Trout</u>	<u>°C</u>
Egg and fry development	14.4 (58 °F)	Egg and fry development	14.4 (58 °F)
Juvenile rearing	21.1 (70 °F)	Juvenile rearing	22.2 (72 °F)
Adult migration	21.7 (71 °F)	Adult migration and holding	22.2 (72 °F)

Reference lines at 14.4 °C and 22.2 °C have been placed on Figures 3-17, as appropriate, to roughly represent the water temperatures suitable for salmonid spawning migration, egg and fry development, and juvenile rearing.

1. Spring 1965 Fall-run Chinook Salmon Juvenile Emigration Survey by Eric Gerstung: The following water temperature data were reported in this survey. **Source:** Hand written draft of May 25, 1965 memorandum in CDFG, Region 2 files.

Date	Time	Temp. (°F)	Location
3/8/65	1055	56	South channel, 100 yards upstream of Gladding Rd.
3/15/65	1315	59	South channel, 100 yards upstream of Gladding Rd.
3/8/65	1105	57	North channel, 100 yards upstream of Gladding Rd.
3/15/65	1330	58	North channel, 100 yards upstream of Gladding Rd.
3/17/65	1115	54	North channel, 100 yards upstream of Gladding Rd.

Source: Hand written draft of May 25, 1965 memorandum in CDFG, Region 2 files.

2. 1984 Seining and Electrofishing for Native Brood Year 1983 Fall-run Chinook Salmon. **Source:** unsigned, unidentifiable author note in CDGFG, Region 2 files.

Date	Time	Water Temp. (°F)	Location
2/28/84	--	--	McCourtney Road
2/28/84	1030	46	Highway 65
3/27/84	1000	67	McCourtney Road
3/27/84	0900	67	Highway 65
5/2/84	1100	53	McCourtney Road
5/2/84	0900	60	Highway 65
5/24/84	--	70	Highway 65

Source: Unsigned, unidentifiable author note in CDFG, Region 2 files.

3. Dowd Road Juvenile Trapping Survey May 9-17, 1992: This data is from a short-term juvenile chinook salmon trapping program on Coon Creek. The trapping location was located approximately 100 yards downstream of Dowd Road. **Source: Unsigned, unidentifiable author note in CDFG, Region 2 files.**

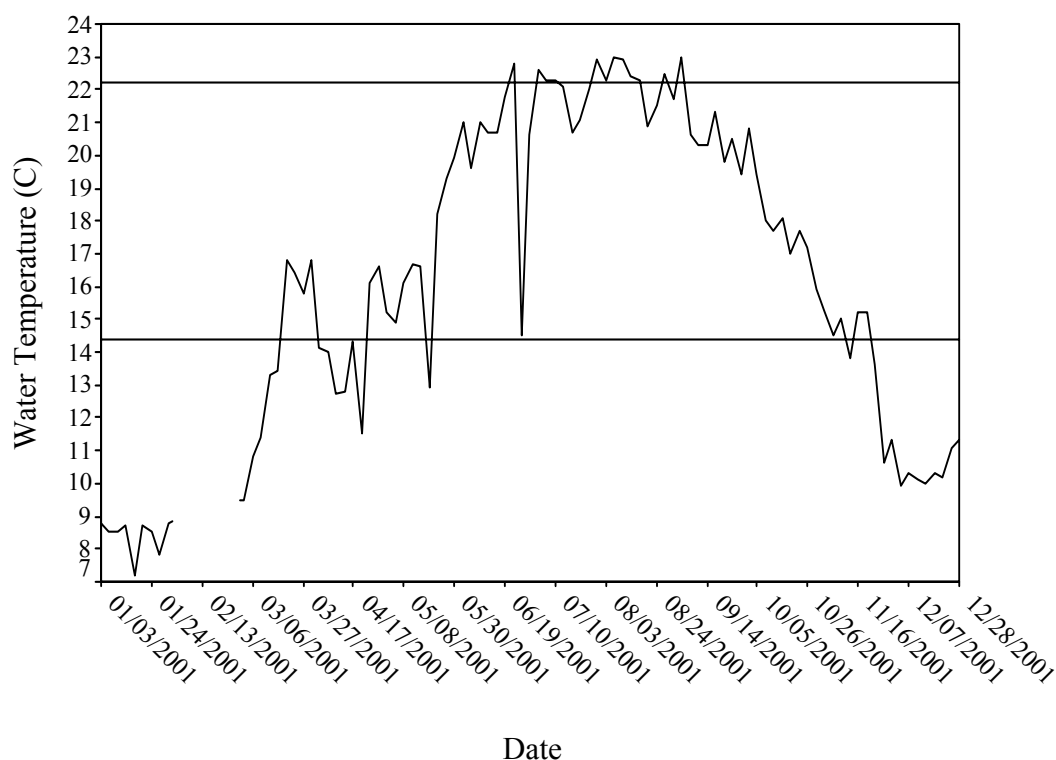
Date	Time	Water Temp. (°F)	Location
5/10/92	0850	65	100 yards downstream of Dowd Rd.
5/11/92	0630	62	100 yards downstream of Dowd Rd.
5/12/92	0630	63	100 yards downstream of Dowd Rd.
5/13/92	0600	66	100 yards downstream of Dowd Rd.
5/14/92	0600	64	100 yards downstream of Dowd Rd.
5/15/92	0700	60	100 yards downstream of Dowd Rd.
5/16/92	0630	65	100 yards downstream of Dowd Rd.
5/17/92	0620	65	100 yards downstream of Dowd Rd.

Source: Unsigned, unidentifiable author note in CDFG, Region 2 files.

4. Department of Fish and Game One-Time Seining Event: CDFG conducted a one-day fish sampling on Coon Creek just upstream of Highway 65 on April 5, 1983. Water temperature was recorded as 54 °F at 0845. **Source: Unsigned, unidentifiable author note in CDFG, Region 2 files.**

5. NPDES Monitoring Data from Placer County's Wastewater Treatment Plant (SMD #1): Water temperatures are monitored routinely as a condition of the County's NPDES permit requirements. Figure 3 shows data from calendar year 2001. Approximately 20 years of data are available. I chose only station R-4 to highlight because it is the station at the downstream mixing zone of the discharge and represents the most likely water temperatures that would be present in Coon Creek at its beginning. **Source: NPDES Monitoring Data from Placer County's Wastewater Treatment Plant (SMD #1), unpublished data.**

Figure 3. Water temperatures from NPDES monitoring station R-4, Dry Creek/Coon Creek, during 2001. These data show that temperatures in this year were adequate to support anadromous fish spawning and rearing.



6. FEIR Teichert Aggregate Facility: Limited data on water temperatures from the site are presented in the FEIR. However, Warren Shaul of Jones and Stokes has stated that they now have 4 years of data. This data is already presumed to be in the County's possession and is not presented in this report. **Source: FEIR Teichert Aggregate Facility 2000, Placer County Planning Dept. and Warren Shaul, Jones and Stokes, pers. comm.**

7. Water Temperature Information from Bailey Environmental September 2001 to August 2003: Figures 4-8 display water temperatures recorded at the Foggy Ranch property, just upstream of Garden Bar Road. Monitoring at this station began in September 2001, but the temperature sensor has been stolen once and experienced a major malfunction, so there are gaps in the record. Temperature data has also been collected at the Tahti property, just upstream of Gladding Road during the same time period (Figures 9-14). New stations were established in late-May to early-June 2003 under the County's monitoring program. These stations are located on the Zobel property (Figure 15) in Dry Creek downstream from County wastewater treatment plant (SMD #1), at the Coon Creek Trap Club (Figure 16) near the Sutter County line, and at the Nicolaus Road crossing (Figure 17). All of the data are presented in the body of this report because of the short period of record for most stations. **Source: Bailey Environmental, unpublished data.**

Figure 4. Water temperature time series for Coon Creek at the Foggy Ranch, just upstream of Garden Bar Road, September through December 2001. Data indicate that successful fall-run chinook salmon spawning could have begun in late October/early November 2001 and that conditions were suitable for juvenile rearing.

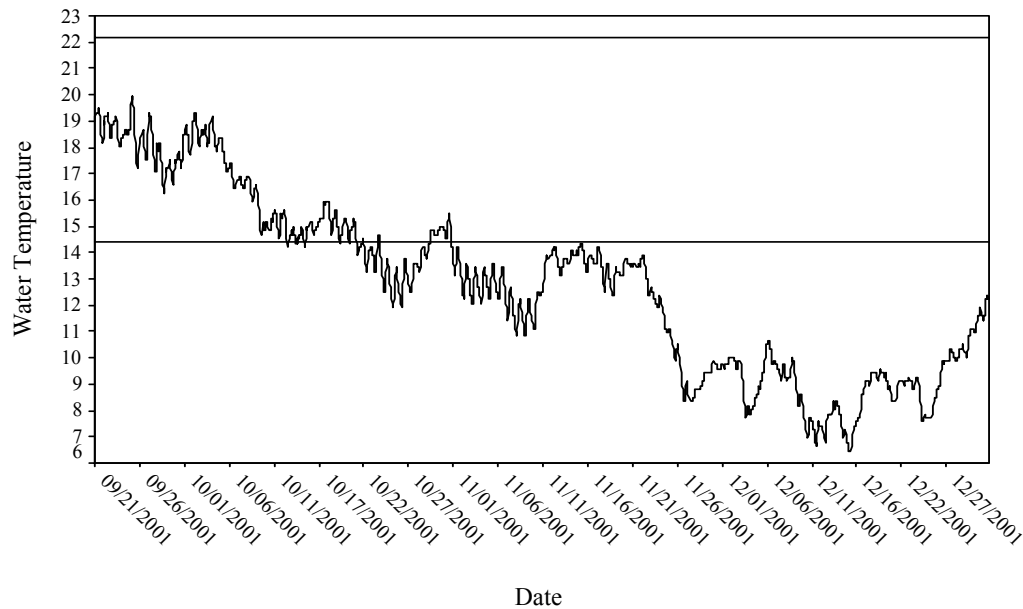


Figure 5. Water temperature time series for Coon Creek at the Foggy Ranch property, just upstream of Garden Bar Road, during the period January through April 2002. Some data are missing because of sensor failure or theft. Temperatures are suitable for egg incubation and juvenile rearing.

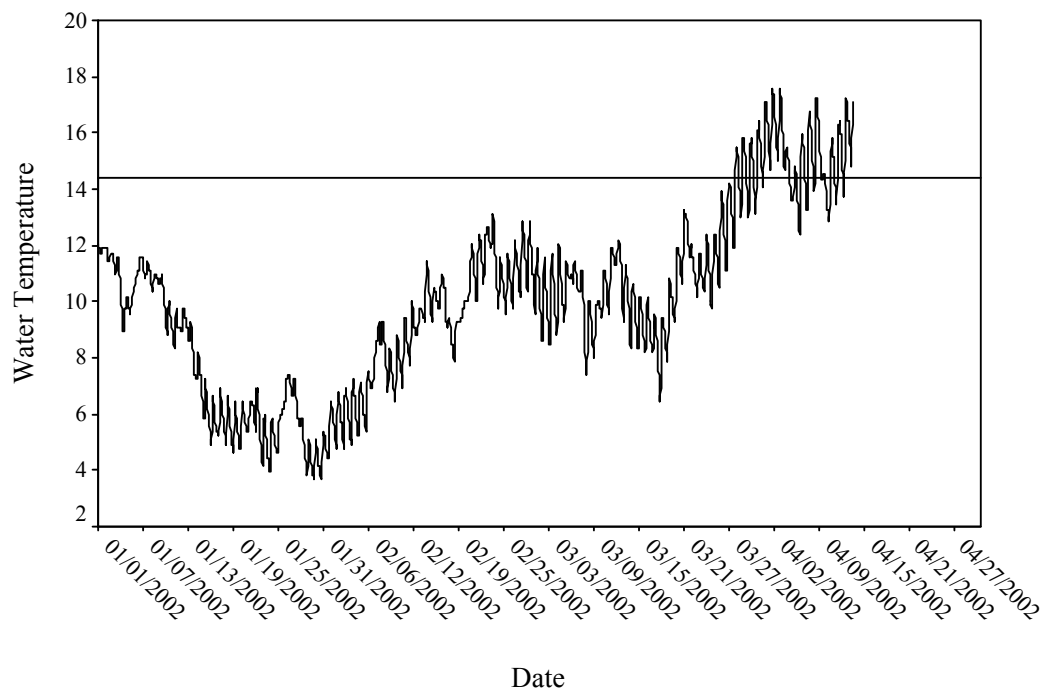


Figure 6. Water temperature time series for Coon Creek at the Foggy Ranch, just upstream of Garden Bar Road, October 22-24, 2002.

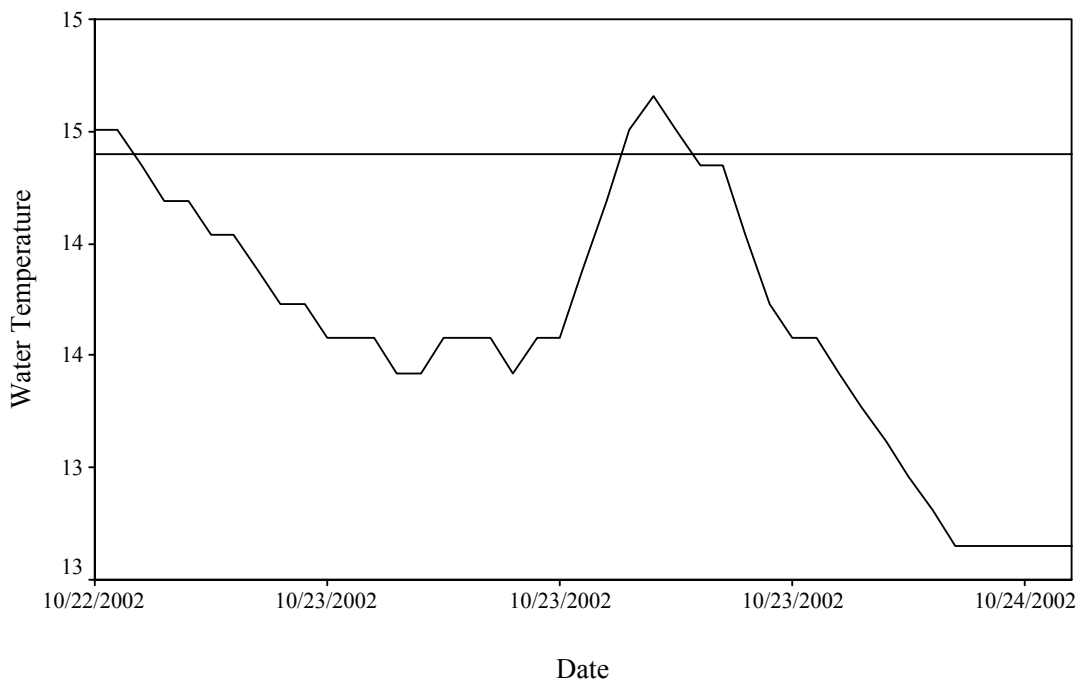


Figure 7. Water temperature time series for Coon Creek at the Foggy Ranch property, just upstream of Garden Bar Road, during the period January through April 2003. Temperatures are suitable for egg incubation and juvenile rearing.

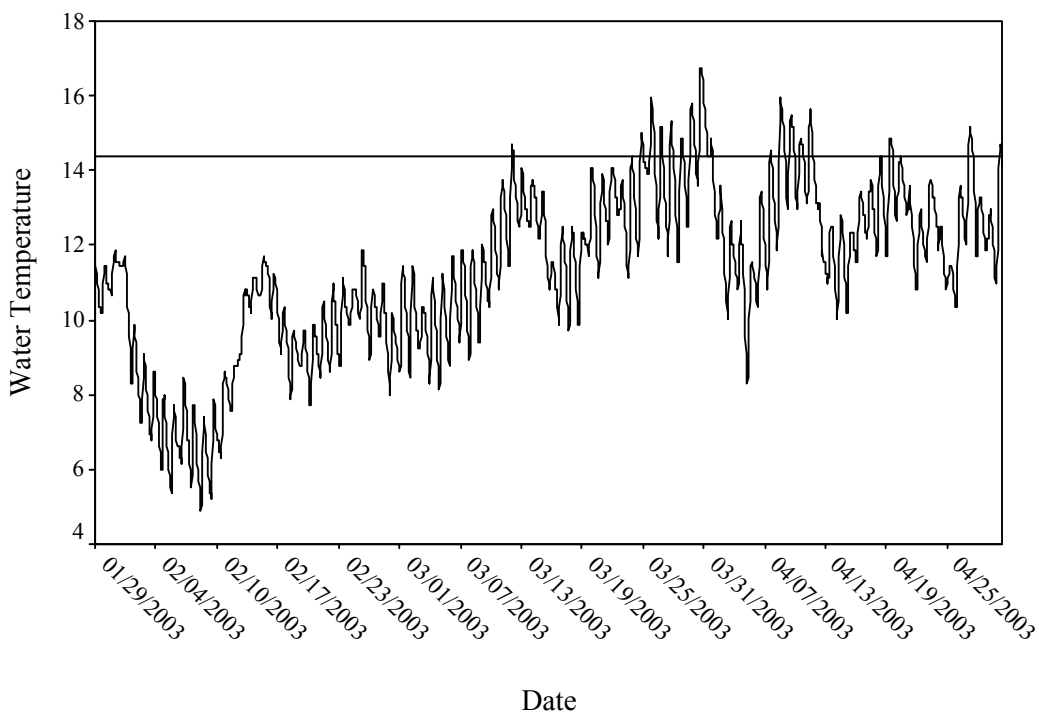


Figure 8. Water temperature time series for Coon Creek at the Foggy Ranch, just upstream of Garden Bar Road, during the period May through August 4, 2003. Temperatures are generally poor for juvenile rearing. This reach would be suitable only if movement to thermal refugia is feasible.

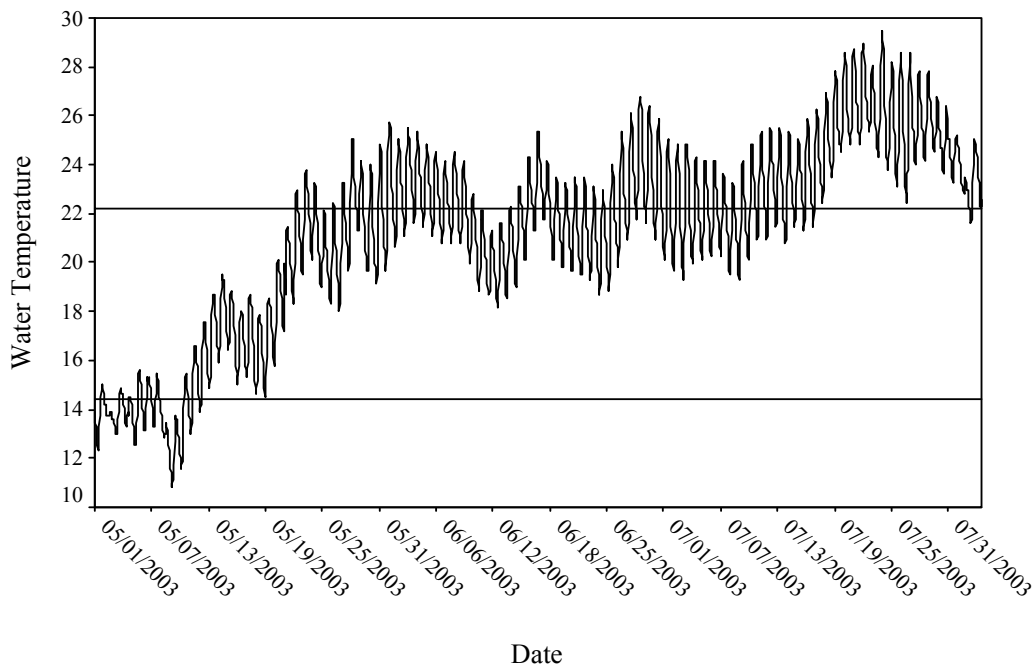


Figure 9. Water temperature time series for Coon Creek at the Tahti property, just upstream of Gladding Road, September through December 2001. These data indicate that successful fall-run chinook salmon spawning could have commenced in late October to early November in 2001 and that conditions were suitable for juvenile rearing.

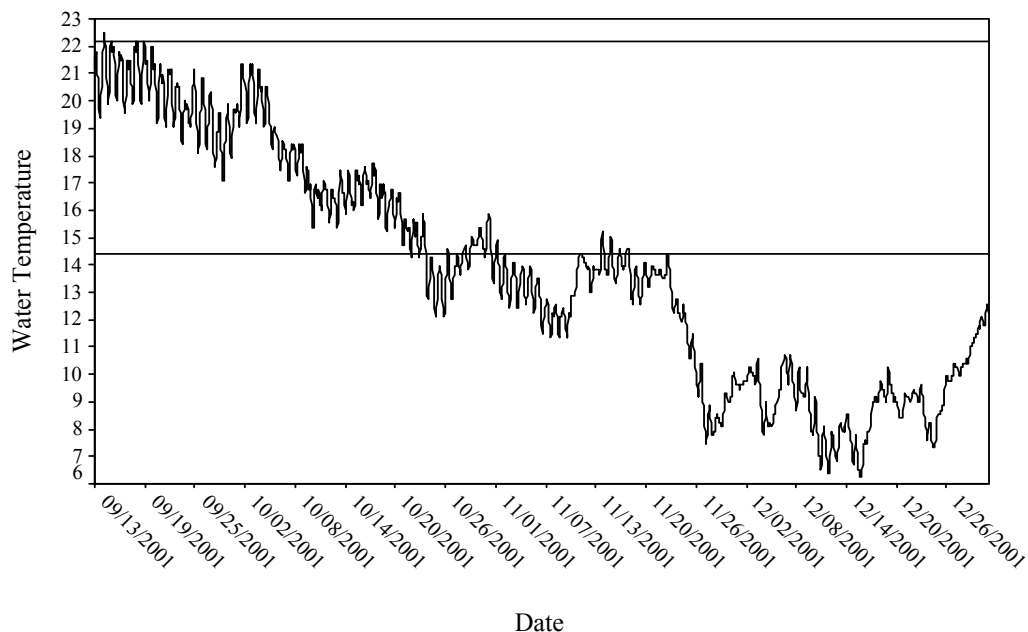


Figure 10. Water temperature time series for Coon Creek at the Tahti property, just upstream of Gladding Road, during the period January through April 2002. Temperatures are suitable for incubation and rearing.

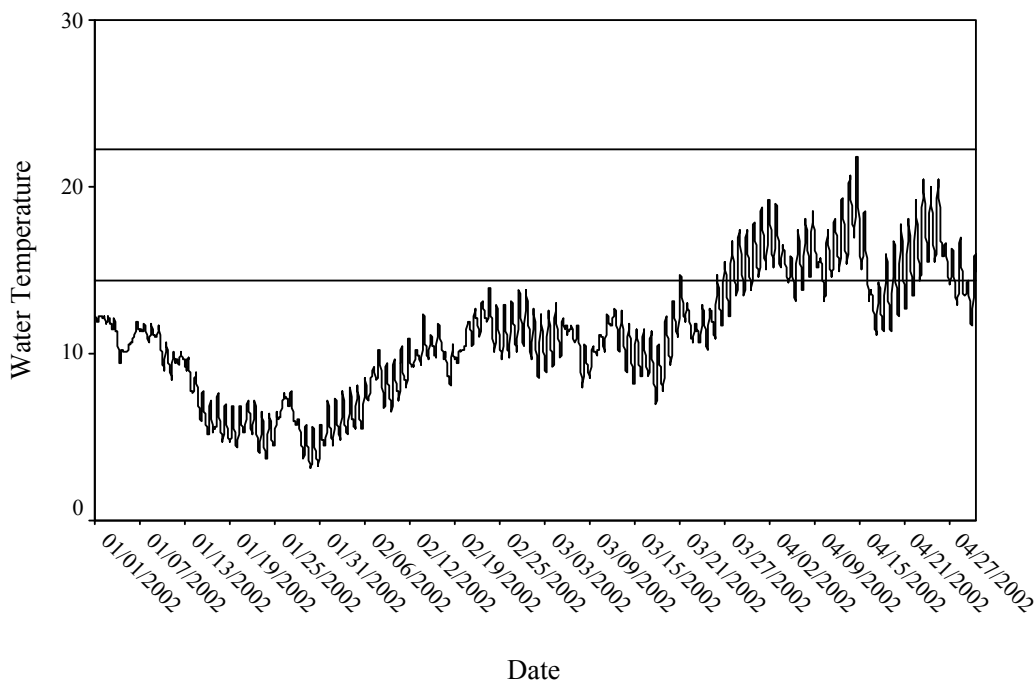


Figure 11. Water temperature time series for Coon Creek at the Tahti property, just upstream of Gladding Road, during the period May through August 2002. Temperatures are marginal to unsuitable for rearing, depending on the availability of thermal refugia.

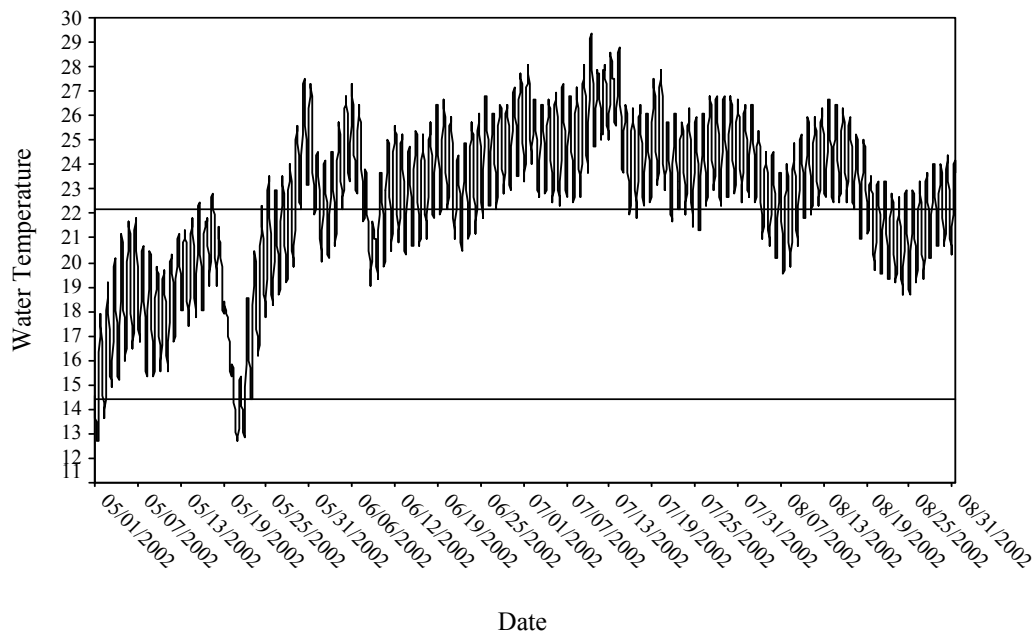


Figure 12. Water temperature time series for Coon Creek at the Tahti property, just upstream of Gladding Road, September through October 22, 2002 (data for October 23 to January 29, 2003 is missing). Successful fall-run chinook salmon spawning could have begun in late October and conditions were suitable for juvenile rearing.

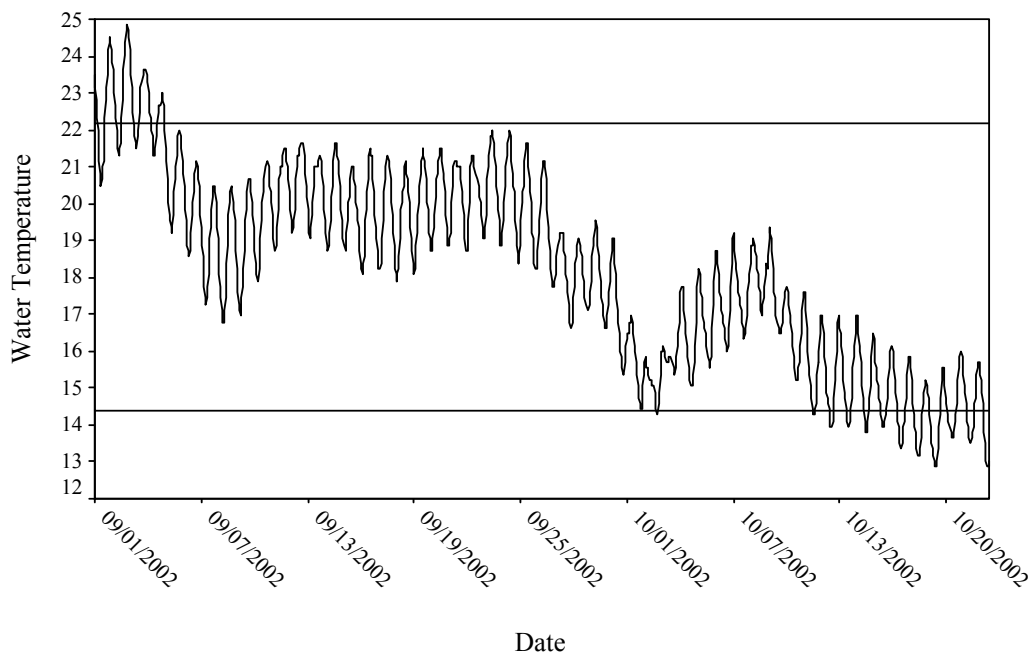


Figure 13. Water temperature time series for Coon Creek at the Tahti property, just upstream of Gladding Road, during the period January through April 2003. Temperatures are suitable for incubation and rearing.

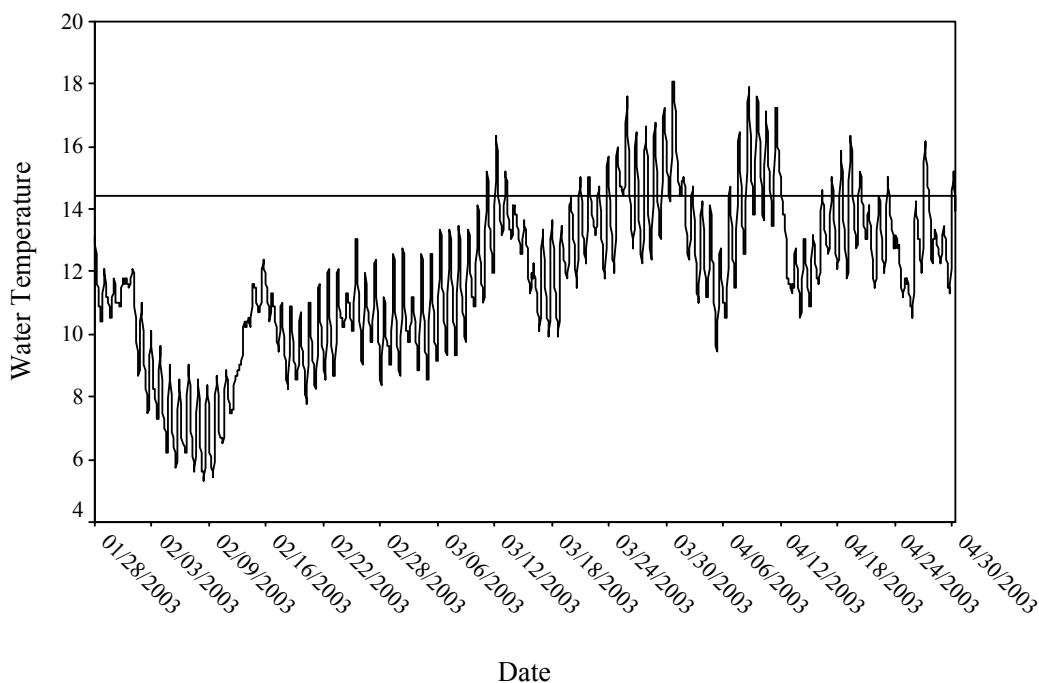


Figure 14. Water temperature time series for Coon Creek at the Tahti property, upstream of Gladding Road, May through August 4, 2003. Temperatures are marginal for juvenile rearing. This reach would be suitable only if movement to thermal refugia is feasible.

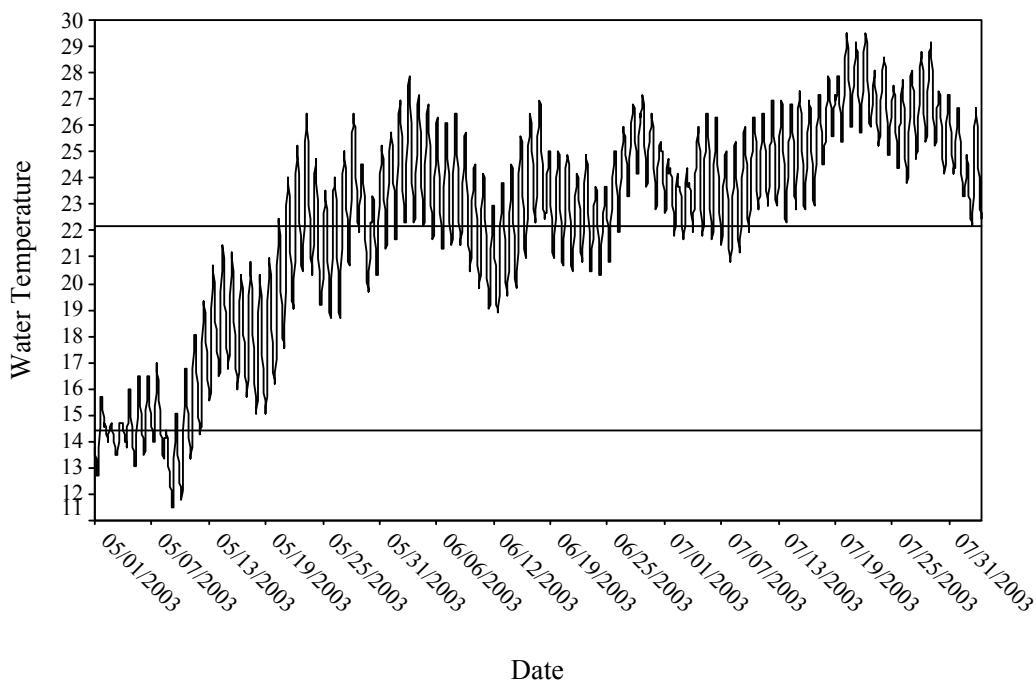


Figure 15. Water temperature time series for Dry Creek/Coon Creek at the Zobel property, June 8 through August 4, 2003. Temperatures are marginal for juvenile rearing. This reach would be suitable only if movement to thermal refugia is feasible.

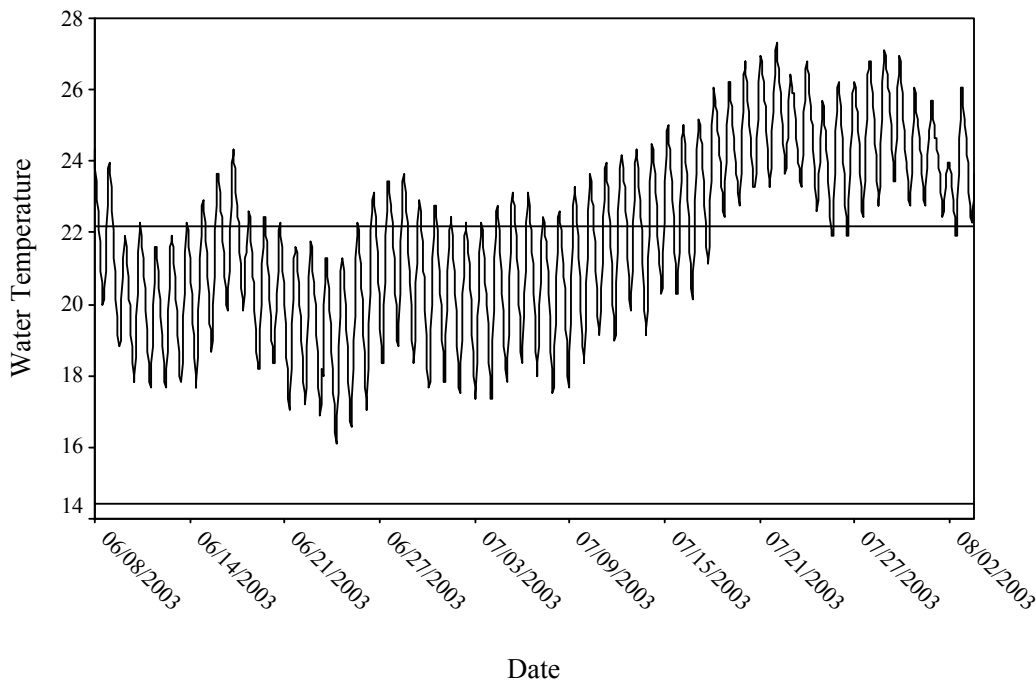


Figure 16. Water temperature time series for the Coon Creek Trap Club, during the period May 28 through August 4, 2003. Temperatures are marginal for juvenile rearing. This reach would be suitable only if movement to thermal refugia is feasible.

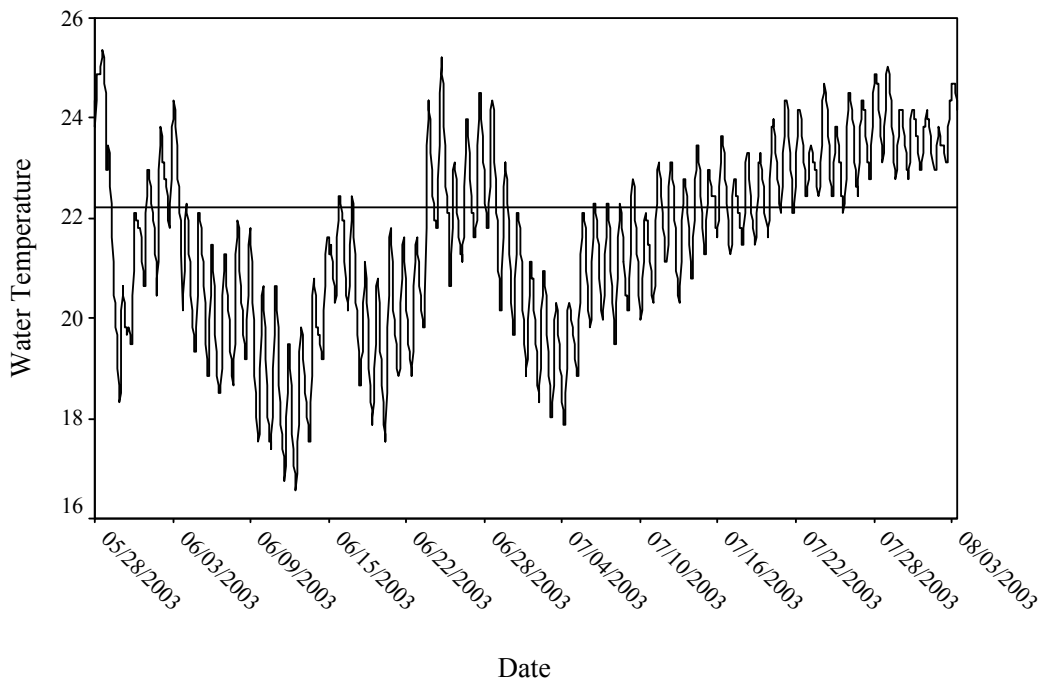
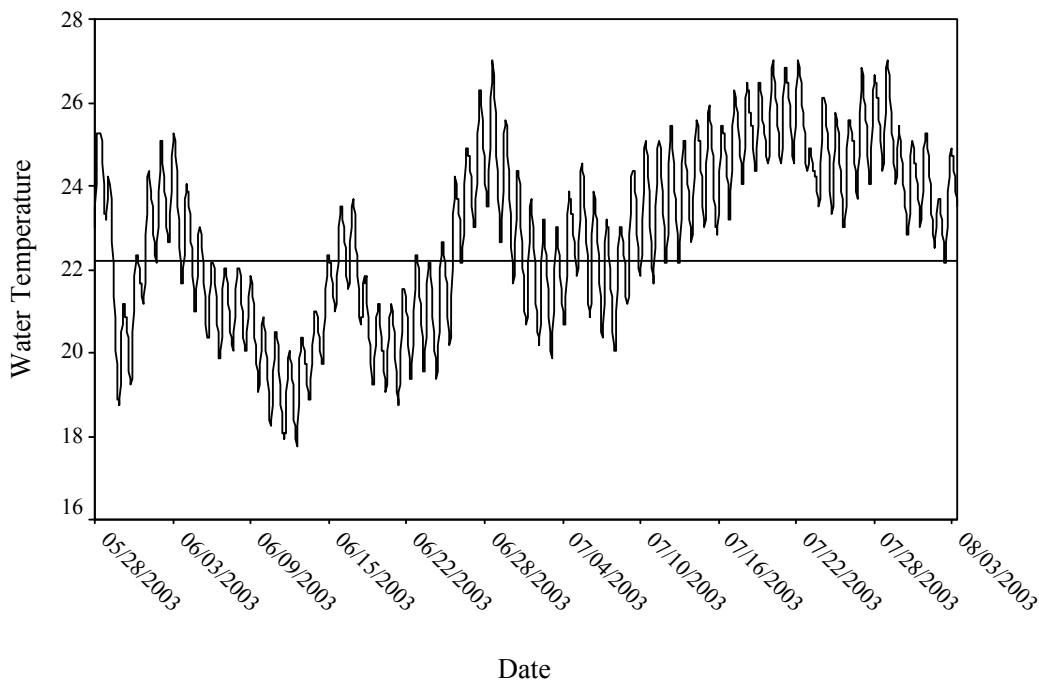


Figure 17. Water temperature time series for Coon Creek at the Nicolaus Road crossing, May 28 through August 4, 2003. Temperatures are marginal for juvenile rearing. This reach would be suitable only if movement to thermal refugia is feasible.



C. Benthic Invertebrate Data

Limited benthic macroinvertebrate data (see Appendix Coon Creek 2 for the complete data set) have been collected from Coon Creek at the Fleming property, downstream of Garden Bar Road. A single sample was collected in December 2000. The data are of limited value. First, samples are collected with equipment that does not readily collect all taxon present in the stream. Second, during the initial sorting, less than 100 individuals were selected for taxonomic identification. This limited sample size raises concerns regarding the representativeness of the data. However, the data do indicate that organisms that are moderately to highly tolerant of water quality impairment dominate the invertebrate community. It is probable that some combination of flow fluctuations, water quality, and the amount of sediment in the stream channel contributes to this general lack of diversity and tendency towards species that are pollution tolerant. **Source: Benthic Macroinvertebrates sampled from Placer County Streams. Prepared for the Auburn Ravine Group by BioAssessment Services, Folsom, CA. December 2002.**

D. Physical Habitat Data

1. **April-May 2000 Physical Habitat Survey Conducted by Stacy Li, et. al, for CalSPA:**

This survey was conducted as part of a court settlement between County of Placer and the California Sportfishing Protection Alliance (CalSPA) regarding Clean Water Act violations at the SMD#1 treatment plant on Joeger Road. The survey area runs from Gladding Road upstream to a large waterfall/cascade on the Spear Ranch property upstream in the canyon above Garden Bar Road. The sampling protocol is based on USDA Forest Service Fish Habitat Relationships program. A list of parameters recorded in the survey is shown below (some variables recorded have not been decoded or interpreted from the field notes). Bailey Environmental is currently the custodian of this data for CalSPA, but data entry and analysis are not complete. Photos were taken of some areas, but they have not been identified to a specific habitat unit. **Source: California Sportfishing Protection Alliance, unpublished data.**

Parameters Recorded	Parameters Recorded	Parameters Recorded
Date Sampled	Water Turbulence Rating	Hydraulic Complexity
Unit Number	Maximum Pool Depth (ft)	Structural Complexity
Primary Habitat Type	Water Depth at Pool Tail Crest (ft)	Left Stream Bank Soil Composition
Secondary Habitat Type	Dominant Substrate Ranking	Right Stream Bank Soil Composition
Pool Type	Subdominant Substrate Ranking	Left Stream Bank Slope Ranking
Number of Channels in the Habitat Unit	Area of Spawning Gravel (sq. ft.)	Right Stream Bank Slope Ranking
Channel Surveyed	Quality of Spawning Gravel Ranking	Left Stream Bank Height (ft)
Flow Split for Multiple Channels (L,M,R)	Quality of Spawning Gravel Constraints Ranking	Right Stream Bank Height (ft)
Cumulative Length to	Rearing Habitat Quality	Left Stream Bank

Habitat Unit Downstream End (ft)	Ranking	Stability Ranking
Cumulative Length to End of Habitat Unit Upstream (ft)	Rearing Habitat Quality Constraints Ranking	Right Stream Bank Stability Ranking
Length of Habitat Unit (ft.)	Area of Aquatic Vegetation (sq. ft.)	Left Stream Bank unknown
Channel Width (ft)	Area of Woody Debris (sq. ft.)	Left Stream Bank Floodplain Connectivity Ranking
Channel Area	Benthos Quality Potential Ranking	Right Stream Bank Floodplain Connectivity Ranking
Water Velocity Rating	Terrestrial Drift Quality Potential Ranking	Left Stream Bank Floodplain Terrace Present
Right Stream Bank Floodplain Terrace Present	Left Stream Bank Vegetative Armor Ranking	Right Bank Vegetative Armoring
Left Stream Bank Riparian Complexity Rating	Right Stream Bank Vegetative Armor Ranking	Notes
Right Stream Bank Riparian Complexity Rating	Left Bank Vegetative Armoring	

Source: California Sportfishing Protection Alliance, unpublished data.

2. FEIR Teichert Aggregate Facility: Jones and Stokes Associates conducted a 1999 habitat survey in the Coon Creek channel from Highway 65 upstream to Gladding Road. The survey protocol is reported to be the same as used by Stacy Li and referenced immediately above. Reference is made to some partial habitat surveys made in 1994 and 1995 and a simple comparison between the percentages of pools, runs, and riffles is presented for the 1999 and 1994-95 surveys for comparable stream channel areas. The following table comes from a Technical Memorandum presented in Appendix J14 of the FEIR and describes the physical habitat conditions found during the 1999 survey. **Source: FEIR Teichert Aggregate Facility 2000, Placer County Planning Dept.**

Habitat Type	Total Length (ft.)	Percent of Total Habitat Surveyed
Mid-Channel Pool	11,114	48.0
Lateral Scour Pool	2,014	8.7
Dammed Pool	51	0.2
Channel Confluence Pool	136	0.6
Run	3,372	14.6
Glide	983	4.3

Low-Gradient Riffle	5,452	23.6
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Source: FEIR Teichert Aggregate Facility 2000, Placer County Planning Dept.

3. 2003 Placer County Spawning Gravel Survey: During the summer of 2003, Placer County funded a survey to examine steelhead trout spawning gravels in this drainage (as well as others). No data are currently available from this effort.

4. 2003 Placer County Stream Videography Project: On March 12, 2003 Coon Creek was videotaped from the air, beginning at Highway 49 in Auburn, downstream into the Eastside Canal near its confluence with Auburn Ravine. Review of the video footage shows the riparian area of the stream varies from very poor quality (downstream areas) to very high quality (upstream of Gladding Road). Also, this footage revealed extensive bank erosion that is contributing to the sediment load in the stream. The proportion of the excessive sediment load attributable to bank erosion versus decomposition of underlying rock formations is unknown. Sediment contributions from land disturbing activities and roadways are also unknown. Based on the video footage, the downstream reach (below Gladding Road) should be considered as a migratory corridor only. This area is mostly sand bottomed, low gradient channel with little potential for accommodating good quality spawning or rearing habitats for anadromous fish. The area between Gladding Road and the waterfalls/cascade section in the canyon upstream of Garden Bar Road appears to be suitable spawning and rearing area for both chinook salmon and steelhead trout. The area upstream of the waterfalls/cascades physically appears to be excellent steelhead and potentially good chinook habitat, if fish passage were provided into this section of the stream. **Source: 2003 Placer County Stream Videography Project, unpublished data.**

E. Fishery Resource Data

1. Documented Fish Species Present in the Stream

California roach	Brook lamprey
Pacific lamprey (indirect evidence)	Green sunfish
White catfish	Log perch
Bullhead (no species given)	Golden shiner
Bluegill	Mosquitofish
Carp	Hitch
Rainbow trout/steelhead	Hardhead
Sacramento sucker	Brown trout
Fall-run chinook salmon (native)	
Fall-run chinook salmon (introduced – Feather River Fish Hatchery)	
Fall-run chinook salmon (introduced – Nimbus Fish Hatchery)	
Spring chinook salmon (introduced – Feather River Fish Hatchery)	
Sacramento pikeminnow (formerly known as Sacramento squawfish)	

Source: California Department of Fish and Game, Region 2 files, Teichert Aggregate Facility FEIR

2. Fish Stocking Records

The following stocking records were found in CDFG's Region 2 files:

Species	Origin	Date	Size (No./lb)	Mean Length*	Number Stocked	Location
Brown trout	Mt. Shasta	6/25/30			30,000	Dry Creek tributary to Coon Creek
Brown trout	Mt. Shasta	7/1/32			10,000	Dry Creek tributary to Coon Creek
Rainbow trout	Mt. Shasta	8/8/45	12	150	1,308	USGS Quad Map coordinates indicate Dry Creek in Auburn
Spring chinook	Feather R. FH	2/21/85	616	45	104,720	Gladding Road
Fall-run chinook	Feather R. FH	2/3/86	480	48	24,000	McCourtney Road
Fall-run chinook	Feather R. FH	1/28/87	704	42	24,640	McCourtney Road
Fall-run chinook	--	1/11/89	1,072	37	100,700	McCourtney Road
Fall-run chinook	Nimbus FH	1/25/90	1,245	35	124,500	McCourtney Road
Fall-run chinook	Feather R. FH	2/26/92	764	41	114,600	Garden Bar Road
Fall-run chinook	Nimbus FH	2/19/93	1,165	36	50,095	Garden Bar Road
Fall-run chinook	Nimbus FH	2/22/93	1,165	36	50,095	Garden Bar Road
Fall-run chinook	Nimbus FH	2/3/94	1,100	37	107,800	Garden Bar Road
Fall-run chinook	Nimbus FH	2/6/95	1,040	37	99,840	Garden Bar Road
Fall-run chinook	Nimbus FH	1/9/96	1,200	36	102,000	Garden Bar Road
Fall-run chinook	Nimbus FH	2/26/97	720	42	102,000	Garden Bar Road

*Length estimates (mm) from Fish Hatchery Management, Fish and Wildlife Service, 1992.

3. Adult Spawning Timing, Distribution, and Population Estimates

- **1964 Fall-run Chinook Salmon Spawning Survey by Eric Gerstung:** Gerstung noted on November 23, 1964 that local ranchers indicated that no run came upstream to spawn

this fall. No survey was conducted on Coon Creek. **Source: May 25, 1965 memorandum in CDFG, Region 2 files.**

- **December 6, 1985 Spawning Survey:** Two locations on Coon Creek were surveyed for fall-run chinook salmon on 12/6/85. The first location was approximately one mile upstream and downstream of Garden Bar Road. The second location was a ¼ mile survey downstream of McCourtney Road. No fish or redds were observed. A 4ft. waterfall was noted one mile downstream of Garden Bar Road. This might be a barrier at certain flows. Flows were estimated at 20-40 cfs, with higher flows earlier. **Source: Unsigned, unidentifiable author note in CDFG, Region 2 files.**
- **1991 Memorandum entitled “Recollection of Auburn Ravine Creek, Coon Creek and Dutch Ravine Creek by Ancle “Slim” Goodall”:** This memo documents the memories of Mr. Goodall regarding his fishing and species caught starting in 1939 or 1940. Mr. Goodall fished Coon Creek and Otto recorded “Coon Creek held “spotted native trout” which lived primarily in the shade. Goodall said that the old timers said they’d seen them in the Gold Rush days. Goodall caught trout of this type up to 19 or 20”. The fish had brown spotted backs with a rainbow’s stripe and olden sides below, and looked to him like a cross between a brown and rainbow trout. In addition, he caught sunfish, catfish, perch, pike and steelhead in the upper stretches of Coon Creek. He saw salmon in the stream above the Garden Bar Bridge. They did not go as far upstream as the steelhead. Goodall said Orr Creek held plenty of trout, as well. **Source: May 26, 1991 Conversation Documented by Ron Otto.**
- **Miscellaneous Anecdotal References:** Three local residents have told me that they have seen adult chinook salmon and steelhead in the watershed. Wayne Vineyard remembers removing adult chinook salmon during the fall when he was “a kid” which would be approximately 50+ years ago. Al Fleming told me that he handled a 56-pound adult chinook in the fall of 1985 from the “upper ranch” property, which is just downstream of Garden Bar Road. Mike Wilson, manager of the Foggy Ranch at Garden Bar Road grew up in the watershed and reports seeing adult chinook salmon and steelhead in the vicinity of Garden Bar Road and upstream on a fairly routine basis over the last 30-40 years.

4. Juvenile Distribution and Sampling Data

- **Spring 1965 Fall-run Chinook Salmon Juvenile Emigration Survey by Eric Gerstung:** Gerstung began trapping downstream migrant fall-run chinook juveniles in both channels of Coon Creek just downstream of McCourtney Road on 3/4/1965 and continued through 3/15/1965 and 3/22/65 on the south and north channels, respectively. The stream was sampled using a “riffle” trap or perforated plate trap. The north-channel trap fished a total of 308.75 hours and captured no juvenile chinook salmon. The south channel trap fished a total of 266.25 hours and captured no juvenile chinook salmon. Water clarity was recorded as clear for each day [11-16 days] the traps were checked over this time period. Water temperatures were recorded at the time the traps were checked and are reported above, in the water temperature section of this report. No other fish species catch composition data is reported. **Source: May 25, 1965 memorandum**

in CDFG, Region 2 files, handwritten draft of May 25, 1965 memo, and other handwritten notes.

- **April 1983 One-time Seining Event:** The Department of Fish and Game conducted a one-time seining event on April 5, 1983 just upstream of Highway 65. Catch composition is reported as: one 92 mm chinook juvenile, 3–squawfish, 1-sucker fry, and 1-green sunfish. Water temperature was recorded as 54° F at 0845. **Source: Unsigned, unidentifiable author note in CDFG, Region 2 files.**
- **1984 Seining and Electrofishing for Native Brood Year 1983 Fall-run Chinook Salmon:** Water temperatures for this sampling effort are reported above. The following sampling results are reported for this sampling effort: **Source: Unsigned, unidentifiable author note in CDFG, Region 2 files.**

Date	Effort	No. Chinook	Length Mode (mm)	Length Range (mm)	Other Fish Species	Location
2/28/84	3 seine hauls	0	0	--		McCourtney Road
2/28/84	2 seine hauls	13	62	32-63	1-hardhead 2- squawfish*	Highway 65
3/27/84	Electrofish. No length	55	46	40-51		McCourtney Road
3/27/84	Electrofish. No length	1	63	63		Highway 65
4/10/84	2 seine hauls	0				Highway 65
5/2/84	2 seine hauls	4		71-83	2 – squawfish 2- carp	McCourtney Road
5/2/84	2 seine hauls	2		85-95	30-squawfish	Highway 65
5/24/84	2 seine hauls	0			1-squawfish; 1 – hitch; “lots” of sucker fry	Highway 65

* Sacramento squawfish are now known as Sacramento pikeminnow.

Source: Unsigned, unidentifiable author note in CDFG, Region 2 files.

- **Dowd Road Juvenile Trapping Survey May 9-17, 1992:** This data is from a short-term juvenile chinook salmon trapping program on Coon Creek. The trapping location was located approximately 100 yards downstream of Dowd Road. Four perforated plate traps were installed on 5/9/92 with an additional three traps installed on 5/10/92. Flow during trapping was estimated at 10-20 cfs. **Source: Unsigned, unidentifiable author note in CDFG, Region 2 files.**

Date	Time	Catch Composition
5/10/92	0850	No chinook, mosquitofish, log perch, white catfish, green sunfish, suckers and fry
5/11/92	0630	No chinook, hitch, brook lamprey, squawfish, bluegill, golden shiners

5/12/92	0630	2-chinook \approx 90 mm, adult squawfish, 1-hitch, usual species
5/13/92	0600	No chinook, big suckers \approx 3lbs.
5/14/92	0600	No chinook, usual fish
5/15/92	0700	No chinook, usual fish
5/16/92	0630	No chinook, usual fish
5/17/92	0620	3-chinook \approx equal size, plus 1-93 mm; usual fish

Source: Unsigned, unidentifiable author note in CDFG, Region 2 files.

- 1994-1995 Fish Resource Surveys for the Proposed Teichert Aggregate Facility:**
 Jones and Stokes Associates conducted fish resource surveys on the Wilson and Hoffman ranches in the Coon Creek channel between Highway 65 and Gladding Road. No specifics of the sampling protocol are given. Juvenile chinook salmon are reported as being seen, but were not captured during the sampling. The following catch composition table is adapted from Table 15-1 in the FEIR. **Source: FEIR Teichert Aggregate Facility 2000, Placer County Planning Dept.**

Species Common Name	Length Range (mm)	Number Captured
Sacramento pikeminnow	53-191	49
Sacramento sucker	84-167	45
Hardhead	75-200	11
Hitch	100	1
California roach	83	1
Bullhead sp.	40-85	3
Channel catfish	---	2
Green sunfish	52-55	2

Source: FEIR Teichert Aggregate Facility

F. Fish Passage or Screening Data

1. Man-Made Structures or Pumping Stations

Three diversion structures in the watershed are of interest to this assessment:

- Coppin Dam:** The dam, operated by South Sutter Water District, is located in the Eastside Canal just downstream of its confluence with Auburn Ravine. This is a flashboard diversion dam that operates during the irrigation season, nominally mid-April to October. Since the flashboards are out during the time period when chinook salmon and steelhead adults would be attempting to enter the watershed, this location is not a concern for adult passage. However, there are two anecdotal reports (Ron Otto and Riley Swift, pers. comm.) of half-pounder steelhead migrating upstream in Auburn Ravine during May. This diversion dam is operating during that time period and could provide a passage barrier to these fish. It is unknown if half-pounder steelhead attempt to migrate

upstream into the Coon Creek Watershed. If they do, there is a relatively inexpensive and simple fix to provide passage over this flashboard dam.

- **Concrete Diversion Structure on the Teichert Aggregate Property:** In the FEIR for the Teichert Aggregate Facility, there is discussion and mitigation regarding a concrete flashboard dam on the Wilson property, which is about midway between Gladding Road and Highway 65 (see Figure 15-3 in the FEIR). Review of the videotape from the County's Videography Project shows this concrete diversion dam has been breeched on the south bank by high flows and does not appear to be an adult fish passage problem at this time. However, what appears to be a new concrete weir/chute structure appears to have been placed in and across the entire stream channel upstream, immediately downstream from Gladding Road. From the videotape footage it is impossible to determine the height or water velocity through this structure. This structure is not mentioned in the Fish Resources Chapter of the FEIR, and no fish passage provisions associated with this structure were obvious during review of the videotape. Specific information and specifications regarding are necessary in order to determine if a fish passage impediment is present during certain flows.
- **Camp Far West Ditch Canal Diversion:** Review of the VHS tape for the upper portion of the watershed near Bell Road in North Auburn shows a diversion structure, which I believe is the Camp Far West Ditch Diversion. This structure and unscreened diversion is located upstream of any nominal anadromous fish distribution at this time. However, if anadromous fish passage were provided over the impediments in the canyon portion of the watershed, upstream of Garden Bar Road, then juvenile anadromous fish exclusion concerns would need to be addressed.

Several pumping stations are located along the stream channel. It is unknown if any of these pumping stations pose a major threat to emigrating anadromous fish juveniles. However, I suspect that the risk is minimal from these locations because they are generally not in operation until irrigation season and by the nominal start date of mid-April, water temperatures downstream in the Eastside Canal and Cross Canal are most likely lethal anyway. This situation deserves further evaluation, but it is probably a low priority.

2. Water Flows

Fall and winter water flows are particularly important in Coon Creek. Because water deliveries are curtailed, generally before fall-run chinook salmon attempt to migrate upstream to spawn, the depth of water in the channel can be insufficient to provide adult passage. Adult chinook salmon and steelhead need approximately 1± foot of water depth with some resting pools in order to migrate upstream. Transit time for adult fish from the Cross Canal confluence to upstream of Gladding Road could routinely be accomplished in two to three days. However, adequate water depth is critical and should be taken into consideration concurrently with any fish passage projects for this drainage. The County of Placer has been purchasing water to dilute its flows from SMD #1, but the quantity of water is inadequate to provide fish passage from Auburn downstream to the Eastside Canal.

3. Beaver Dams

Beaver dams and beaver activity are known to adversely affect adult anadromous fish passage in this watershed. During the stream videography project, six beaver dams capable of affecting passage were documented from the air between the confluence with Eastside Canal and the area upstream of the McCourtney Road crossing on March 12, 2003. During the fall/winter of 2002/2003, a major beaver dam was located approximately ¼ mile downstream of the McCourtney Road crossing on the South Channel. This dam remained in place and appeared to block adult fish passage for the entire spawning season for both fall-run chinook and steelhead, although anecdotal evidence from local ranchers indicate that at least one chinook salmon did migrate upstream to the Spear Ranch property upstream of Garden Bar Road. The North Channel appeared to be a barrier all winter long because of low flows.

APPENDIX COON CREEK 1

HEAVY METALS COMPARISON BETWEEN COON CREEK AND EASTSIDE CANAL

	Assumes a Hardness	Maximum	Continuous			
	Of 50 mg/l as CaCO3	Concentration	Concentration			
		(Acute)	(Chronic)			
	METAL	(mg/l)	(mg/l)			
	Barium	No standard	No standard			
	Cadmium	0.002	0.0013			
	Copper	0.007	0.005			
	Zinc	0.067	0.066			
Stream	Location	Date	Cadmium mg/l	Copper mg/l*	Zinc mg/l	Notes
Coon Creek	Sutter County	01/25/01	0.000042	0.00446	0.00658	Hardness = 65 mg/l
Coon Creek	Sutter County	03/01/01	0.000056	0.0106	0.0101	Hardness = 76 mg/l
Coon Creek	Sutter County	04/05/01	0.000028	0.00395	0.00276	Hardness = 72 mg/l
Coon Creek	Sutter County	05/03/01	0.000045	0.00548	0.00376	Hardness = 72 mg/l
Coon Creek	Sutter County	06/06/01	0.000024	0.0458	0.00213	Hardness = 50 mg/l
Coon Creek	Sutter County	07/17/01	0.000019	0.00197	0.00153	Hardness = 173 mg/l
Coon Creek	Sutter County	08/02/01	0.000007	0.0008	0.00096	Hardness = 176 mg/l
Coon Creek	Sutter County	09/06/01	0.000011	0.00284	0.00146	Hardness = 47 mg/l
Coon Creek	Sutter County	10/11/01	0.000013	0.00387	0.00115	Hardness = 65 mg/l
Coon Creek	Sutter County	10/31/01	0.000007	0.00288	0.0014	Hardness = 64 mg/l
Coon Creek	Sutter County	12/21/01	0.000125	0.0157	0.0162	Hardness = 63 mg/l
Cross Canal	Sutter County	01/25/01	0.000039	0.00445	0.00555	Hardness = 65 mg/l
Cross Canal	Sutter County	03/01/01	0.000052	0.011	0.0102	Hardness = 72 mg/l
Cross Canal	Sutter County	04/05/01	0.000014	0.00299	0.00301	Hardness = 46 mg/l
Cross Canal	Sutter County	05/03/01	0.000015	0.00298	0.0019	Hardness = 46 mg/l
Cross Canal	Sutter County	06/06/01	0.000023	0.00214	0.00113	Hardness = 52 mg/l
Cross Canal	Sutter County	07/17/01	No Flow	No Flow	No Flow	No Flow
Cross Canal	Sutter County	08/02/01	0.000015	0.00278	0.00291	Hardness = 59 mg/l
Cross Canal	Sutter County	09/06/01	0.000014	0.00302	0.0026	Hardness = 70 mg/l
Cross Canal	Sutter County	10/11/01	0.000013	0.00343	0.00236	Hardness = 65 mg/l
Cross Canal	Sutter County	10/31/01	0.000015	0.00354	0.00228	Hardness = 63 mg/l
Cross Canal	Sutter County	12/21/01	0.000098	0.0117	0.0158	Hardness = 58 mg/l

* Values in bold exceed California Toxics Rule objectives for aquatic life at a hardness of 50 mg/l.

Sources: California Toxics Rule (water quality objectives); Department of Water Resources unpublished data.

APPENDIX COON CREEK 2

**BENTHIC MACROINVERTEBRATE DATA
COLLECTED BY THE AUBURN RAVINE CITIZENS GROUP**

PHYLUM								
	Class					12/01/00		
		Order				Coon Creek @		
		Family				upper Fleming		
			<i>Genus species</i>	TV ¹	FFG ²	CCF-A	CCF-B	CCF-C
ARTHROPODA								
	Hexapoda							
		Coleoptera (Larvae)						
		Elmidae	5	cg	6	11	6	
		Psephenidae	4	sc		1		
		Diptera						
		Chironomidae	6	cg	20	13	4	
		Empididae	6	p	2			
		Simuliidae	6	cf	7	17	70	
		Tipulidae	3	sh		1		
		Ephemeroptera						
		Baetidae	4	cg	23	18	5	
		Ephemerellidae	1	cg				
		Leptohyphidae	4	cg	8	7	2	
		Plecoptera						
		Capniidae	1	sh				
		Chloroperlidae	1	p				
		Perlodidae	2	p				
		Trichoptera						
		Brachycentridae	1	ot	8	6	1	
		Glossosomatidae	0	sc				
		Hydropsychidae	4	cf	4	8	2	
		Hydroptilidae	4	ot				
		Leptoceridae	4	ot				
		Philopotamidae	3	cf		3	1	
		Lepidostoma						
		Pyalidae	5	sc	2			
		Odonata						
		Coenagrionidae	9	p	4	2		
		Gomphidae	4	p				
		Libellulidae	9	p				
Subphylum Chelicerata								
	Arachnoidea							
		Hydracarina (=Acari)	5	p				
Subphylum Crustacea								
	Malacostraca							
		Amphipoda	4	cg	1			
MOLLUSCA								
	Gastropoda							

[illegible]

						Mean	SE	CST	
					Taxonomic Richness	13	1.3	18	
					EPT Taxa	5	0.3	5	
					Ephemeroptera Taxa	2	0.0	2	
					Plecoptera Taxa	0	0.0	0	
					Trichoptera Taxa	3	0.3	3	
					EPT Index (%)	34	11	34	
					Sensitive EPT Index (%)	7	2.4	7	
					Dominant Taxon (%)	39	18	33	
					Tolerance Value	5.0	0.3	5.0	
					Intolerant Organisms (%)	7	2.6	7	
					Tolerant Organisms (%)	2.5	1.3	2.5	
					Collectors (%)	47	14	47	
					Filterers (%)	40	20	40	
					Grazers (%)	1	0.6	1	
					Predators (%)	6	2.1	6	
					Shredders (%)	0	0.4	0	
					Other (%)	5	2.2	5	
					* Site statistics based on small and variable sample sizes				

CURRY CREEK

The literature review for Curry Creek did not result in any information related to:

- Existing Water Quality Data
- Water Temperature Data
- Benthic Macroinvertebrate Data
- Physical Habitat Data
- Fishery Resource Data
- Fish Passage or Screening Data

I reviewed all of the pertinent environmental documents produced by the City of Roseville and searched the fisheries files at the California Department of Fish and Game's Region 2 office. Since Curry Creek is currently intermittent, environmental documents focus on wetlands, vernal pools, and riparian issues, but not on water quality, benthic macroinvertebrates, or fishery resources. In fact, CDFG does not even have a file for Curry Creek, let alone any data in that non-existent file. However, I did visit all of the accessible road crossings of the channel and during several flights looking for salmon in other drainages, did fly over the stream channel on several occasions. During the stream videography project in March 2003, we did not fly Curry Creek because of time and priority constraints. Therefore, my assessment of this stream's potential to support anadromous fish is based on my limited road crossing and several over flight observations. *[This assessment is basically repeated in the Assessment Report prepared for Placer County].*

A. Water Quality

Assessment: Observations of water quality left me with one solid observation and one impression. During the fall and early winter the turbidity levels were high, with the water being chocolate brown in color. The impression that I have is that nutrient levels might be unsuitable for anadromous fish, should they ever enter the system. This impression is based on the amount of aquatic vegetation growing in the channel, during the winter period and an overall sense of high botanical productivity in the immediate channel area.

B. Water Temperature

Assessment: Although no data is available, my belief is that water temperatures, if perennial flow were to become the norm, would be unsuitable in summer for juvenile salmonid rearing. I base this conclusion on two factors. First, the volume of flow in the channel would be low, unless an artificial discharge supplemented the natural flow, resulting in rapid heating during the spring and summer months. Second, the gradient of the channel is very low which would result in long residence times for water and thus greater opportunity for temperature increases.

C. Benthic Macroinvertebrates

Assessment: In the event the channel did become perennial at some future date, I speculate that the substrate would be composed of fine particles to coarse sand. This substrate would support a low diversity and numbers of organisms that would be suitable as a food source for salmonids.

D. Physical Habitat

Assessment: This stream channel is very low gradient and the surrounding soils are mostly fine textured. Given these constraints, I do not believe that this stream could ever possess the physical characteristics to support salmonid species. The lack of stream power to scour pools and gravels, if any gravel even exists under the existing channel, would render this stream unsuitable as habitat for anadromous salmonids. Also, the lack of sediment transport ability would further hinder the likelihood that suitable conditions could be created. A lack of riparian vegetation would also limit the potential development of habitat complexity.

E. Fishery Resources

Assessment: Based on the location, gradient, soils, and other factors associated with this channel, I believe that this stream has close to zero potential as an anadromous fish stream. The current conditions, and I believe most likely future conditions in the channel do not meet most, if any, of the requirements necessary to support anadromous fish. I do believe that this channel should be kept intermittent, if possible, to avoid false attraction of anadromous species and to minimize the introduction or expansion of undesirable warmwater fish species into other watersheds.

F. Fish Passage or Screening

Assessment: During the over flights, I believe I did see several beaver dams in the lower portion of the drainage, but cannot confirm that observation as fact. If by some chance stream conditions became suitable for anadromous fish, then the beaver situation would have to be dealt with in the manner recommended for other watersheds.

DOTY RAVINE

A. Water Quality Data

1. Lincoln High School Water Quality Monitoring: Mark Fowler and Lee Beckman provided this data from the Lincoln High School sampling program, which was jointly funded by NID, Placer County, and the City of Lincoln. While data for Doty Ravine are limited, three parameters are of concern from a stream ecology standpoint. First, the pH readings from the Garcia Property are relatively high and correlate with a trend of unusually high pH values in the Western Placer County streams, particularly in the fall. Second, the dissolved oxygen concentrations reported show supersaturated levels of approximately 150%, which is unusual for lower gradient streams. This trend is also noted in other local streams. Third, the concentrations of nitrate reported are high for a fall reading and could indicate eutrophication of the stream, particularly during the summer months. Without data on orthophosphate for comparison, it is impossible to determine if nitrates are limiting biostimulation of algal growth and potentially causing diurnal dissolved oxygen fluctuations during the nighttime hours. Excessive algal growth has been observed in other local streams. The limited quantity of water quality data available for Doty Ravine does not allow any definite conclusions to be drawn. **Source: Lincoln High School Water Quality Monitoring, unpublished data.**

Table 1. Doty Ravine Water Quality Data 2001-2002

Parameter	Garcia Property	Garcia Property	Weygant Property	Unnamed NID canal
Date	10/7/2001	10/14/2001	10/27/2002	5/6/2002
Time	1146	0945	--	0620
Air Temperature (°F)	--	--	68	51
Water Temperature (°F)	64	60	56	56
Weather	Clear	Clear	Clear	Clear
Stream Flow (cfs)	2	0.7	1.4	--
pH	8.1	8.7	7.3	8.1
Dissolved Oxygen (mg/L)	16.5	14.1	16.5	16.5
Electrical Conductivity (µs/cm)	106.2	122.1	170.2	61.1
Color (color units)	2	0	5	61
Nitrates (mg/L)	1.8	1.4	0.8	1.0
Chlorides (mg/L)	0.03	0.04	0.00	0.10
Total Coliform (MPN/100ml)	2400	240	43	240
Fecal Coliform (MPN/100ml)	150	240	43	240

Source: Lincoln High School Water Quality Monitoring, unpublished data.

2. Auburn Ravine/Coon Creek Ecosystem Restoration Plan: In the background information for this Plan, there is reference to a one-time sampling conducted by CH2MHill on 2/1/1996. The parameters apparently measured were dissolved oxygen, pH, turbidity, and water temperature, but no data are provided. **Source: unpublished data, Bob Coats, Hydroikos Consulting, San Rafael, CA.**

B. Water Temperature Data

Water temperature data from various one-time fish sampling projects conducted by the CDFG are presented below, most of the data from monitoring conducted by Bailey Environmental, which includes hourly readings. Due to limitations in the statistical package, only 3,000 temperature data points can be displayed in a single time series plot. Since daily maximum, minimum, and/or mean temperatures individually are of little value, I have chosen to plot all data points. Therefore, I have split the year into time periods that roughly correspond to:

Fall-early winter: September through December; primary fall-run chinook salmon spawning period is November-December.

Winter-spring: January through April; fall-run chinook salmon incubation and rearing and steelhead spawning, incubation, and rearing.

Late spring-summer: May to September; summer rearing for steelhead juveniles.

Data plots for these time periods are presented below to allow the reader to assess the potential of Doty Ravine to support chinook salmon and/or steelhead trout spawning and rearing. A variety of local data and literature was reviewed, to characterize the general effects of water temperature on various life history stages for both chinook salmon and steelhead trout. There is fairly substantial variation in temperature effects noted for most life history stages, and both chinook salmon and steelhead are have a highly adaptable physiology and ability to seek thermal refuge during part of the day which may allow them to tolerate and/or avoid lethal temperatures. Some of the literature sources cite criteria from others and some of the data are based on fish captures with water temperature taken concurrently. Two tables with data and reference are included in Appendix A of this report. Based on this review, the following criteria have been used to indicate what life history stages a particular stream may support at any given time:

<u>Chinook Salmon</u>	<u>°C</u>	<u>Steelhead Trout</u>	<u>°C</u>
Egg and fry development	14.4 (58 °F)	Egg and fry development	14.4 (58 °F)
Juvenile rearing	21.1 (70 °F)	Juvenile rearing	22.2 (72 °F)
Adult migration	21.7 (71 °F)	Adult migration and holding	22.2 (72 °F)

Reference lines for 14.4 °C and 22.2 °C have been provided on Figures 1-8 below to roughly represent the water temperatures suitable for salmonid spawning migration, egg and fry development, and juvenile rearing.

- 1. Spring 1965 Fall-Run Chinook Salmon Juvenile Emigration Survey by Eric Gerstung:** The following water temperature data were reported in this survey. **Source:** Hand written draft of May 25, 1965 memorandum in CDFG, Region 2 files.

Date	Time	Temp. (°F)	Location
2/24/65	1145	51	100 yards downstream of Gladding Road crossing
2/25/65	1125	51	100 yards downstream of Gladding Road crossing
2/27/65	1420	56	100 yards downstream of Gladding Road crossing
3/2/65	1200	54	100 yards downstream of Gladding Road crossing
3/3/65	1300	52	100 yards downstream of Gladding Road crossing
3/4/65	1230	54	100 yards downstream of Gladding Road crossing
3/8/65	1040	54	100 yards downstream of Gladding Road crossing
3/11/65	1300	--	100 yards downstream of Gladding Road crossing
3/12/65	1130	--	100 yards downstream of Gladding Road crossing
3/15/65	1240	58	100 yards downstream of Gladding Road crossing
3/17/65	1100	55	100 yards downstream of Gladding Road crossing

Source: Hand written draft of May 25, 1965 memorandum in CDFG, Region 2 files.

- 2. 1984 Seining and Electrofishing for Native Brood Year 1983 Fall-Run Chinook Salmon.** **Source:** Unsigned, unidentifiable author note in CDFG, Region 2 files.

Date	Time	Water Temp. (°F)	Location
2/28/84	1330	53	McCourtney Road
2/28/84	1330	53	Garden Bar Road
3/27/84	1130	56	McCourtney Road
5/2/84	---	53	McCourtney Road

Source: Unsigned, unidentifiable author note in CDFG, Region 2 files.

- 3. Teichert Aggregate Project Area:** A water temperature of 61 °F was measured in Doty Ravine, upstream of Coon Creek, at 1100 hours on April 24, 1995. **Source:** FEIR Teichert Aggregate Facility, County of Placer, December 2001.

- 4. Water Temperature Information from Bailey Environmental September 2001 to August 2003:** Figures 1-6 are for a single temperature monitoring station located approximately 200 yards upstream of the Crosby Herold Bridge crossing on the former property of the Garcia family. This station was discontinued in June 2003 because a new owner installed a new fence making access more difficult. This monitoring location was moved approximately 1,000 ft. upstream to the Munson property in June 2003. Beginning in June 2003, two additional monitoring locations were established at the Wise and Goldhill Road crossings. Data for June-August 2003 are presented in Figures 7 (Wise Road) and 8 (Goldhill Road). **Source:** Bailey Environmental, unpublished data.

Figure 1. Water temperature time series for Doty Ravine at the Garcia property, September through December 2001. Data indicate that successful fall-run chinook salmon spawning could have begun in late October/early November in 2001 and that conditions were suitable for juvenile rearing.

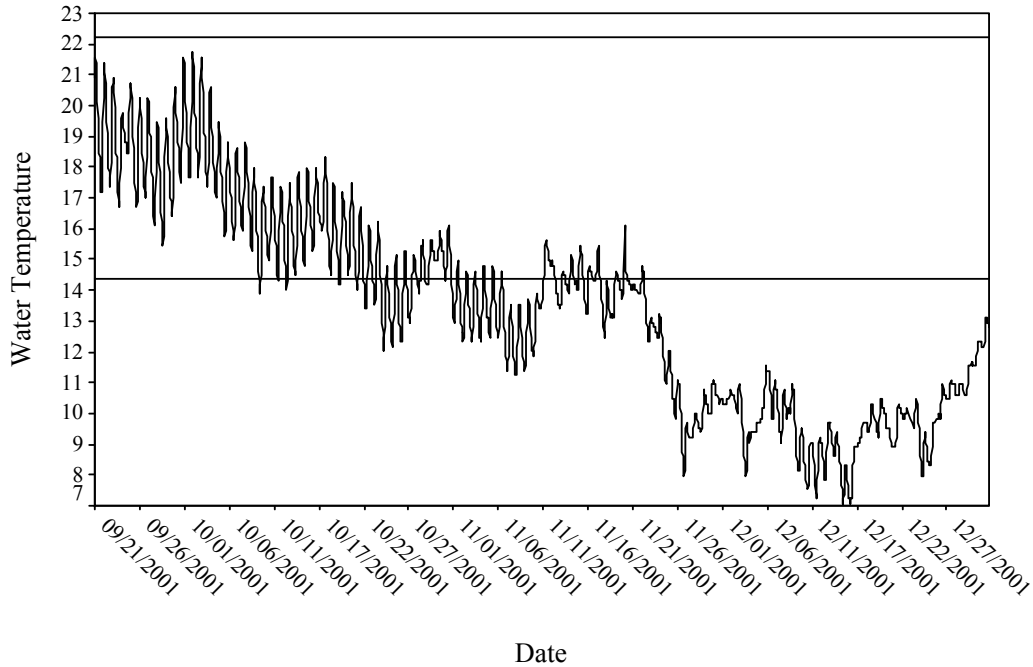


Figure 2. Water temperature time series for Doty Ravine at the Garcia property, January through April 2002. Temperatures are suitable for egg incubation and juvenile rearing.

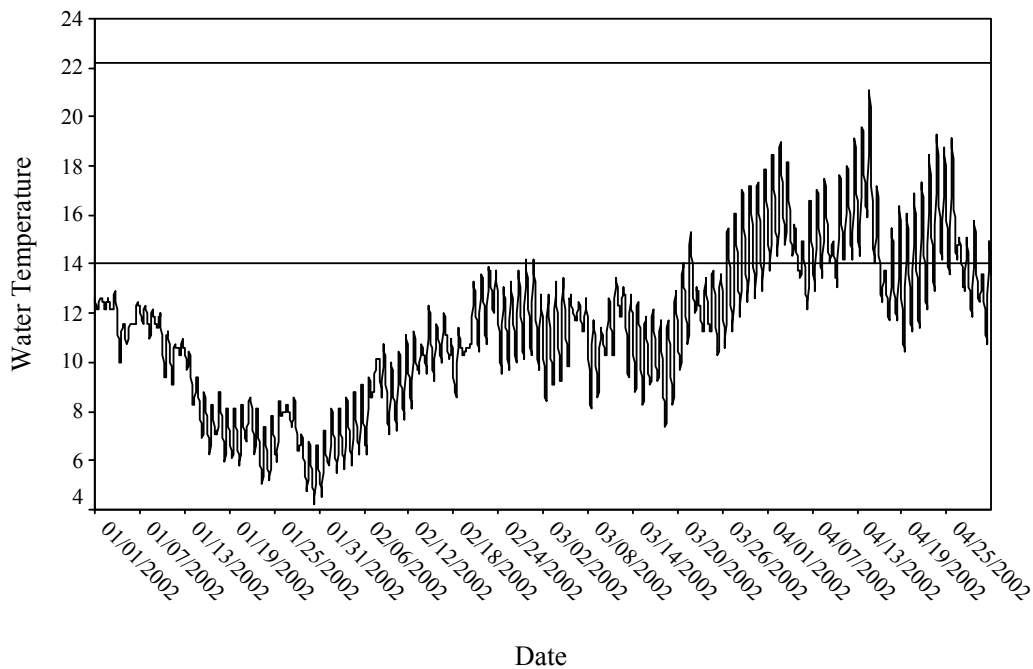


Figure 3. Water temperature time series for Doty Ravine at the Garcia property, May through August 2002. Temperatures are suitable for juvenile rearing, where data exists. However, the critical summer period has no data.

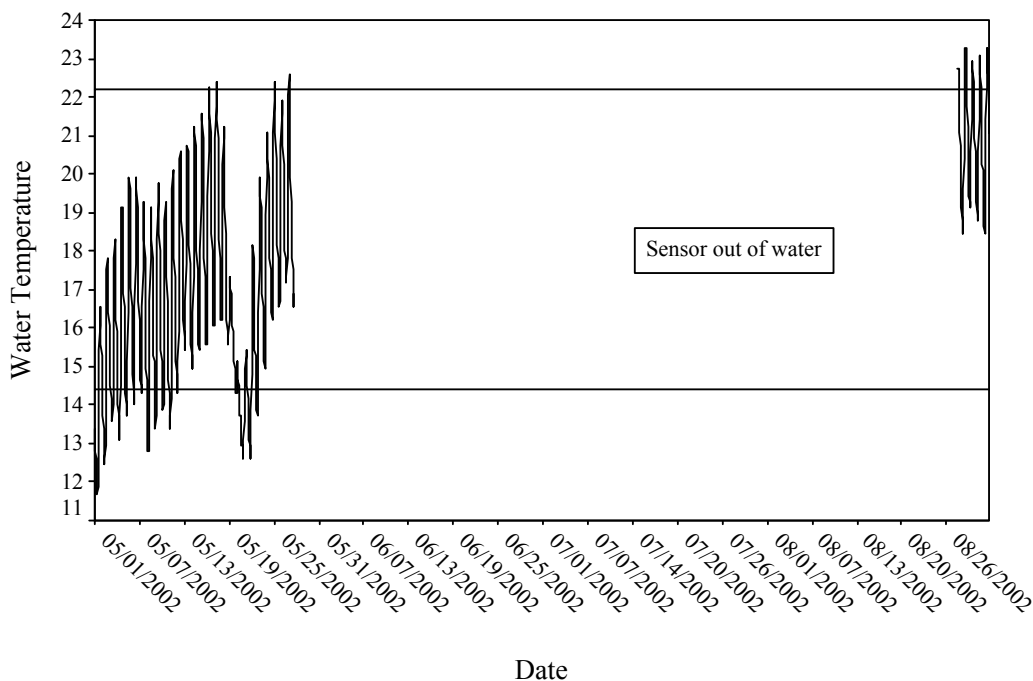


Figure 4. Water temperature time series for Doty Ravine at the Garcia property, September through December 2002. Data indicate that successful fall-run chinook salmon spawning could have begun in late October/early November in 2001 and that conditions were suitable for juvenile rearing.

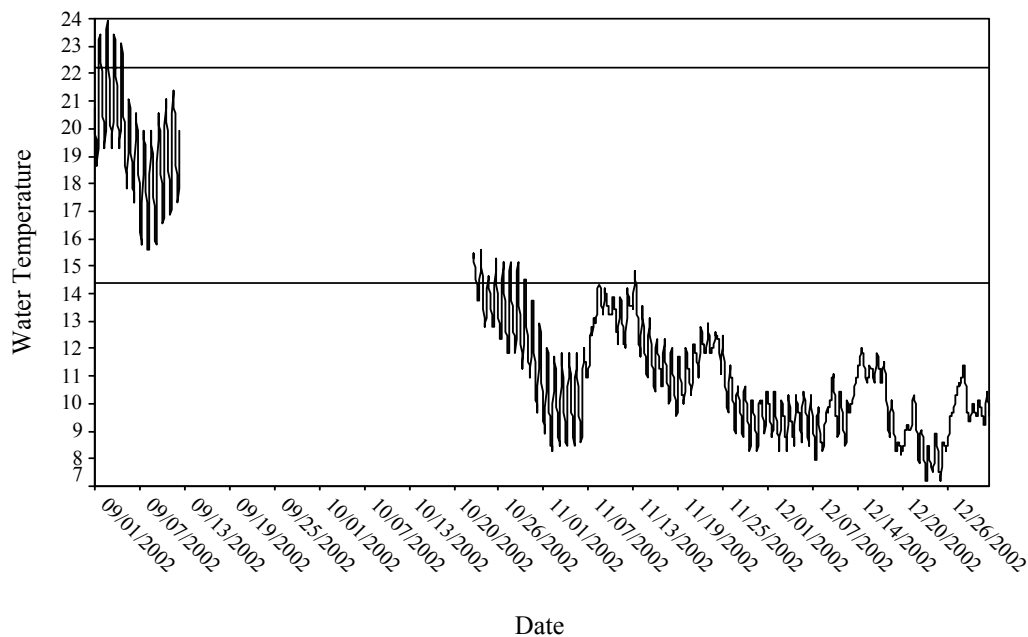


Figure 5. Water temperature time series for Doty Ravine at the Garcia property, January through April 2003. Temperatures are suitable for egg incubation and juvenile rearing.

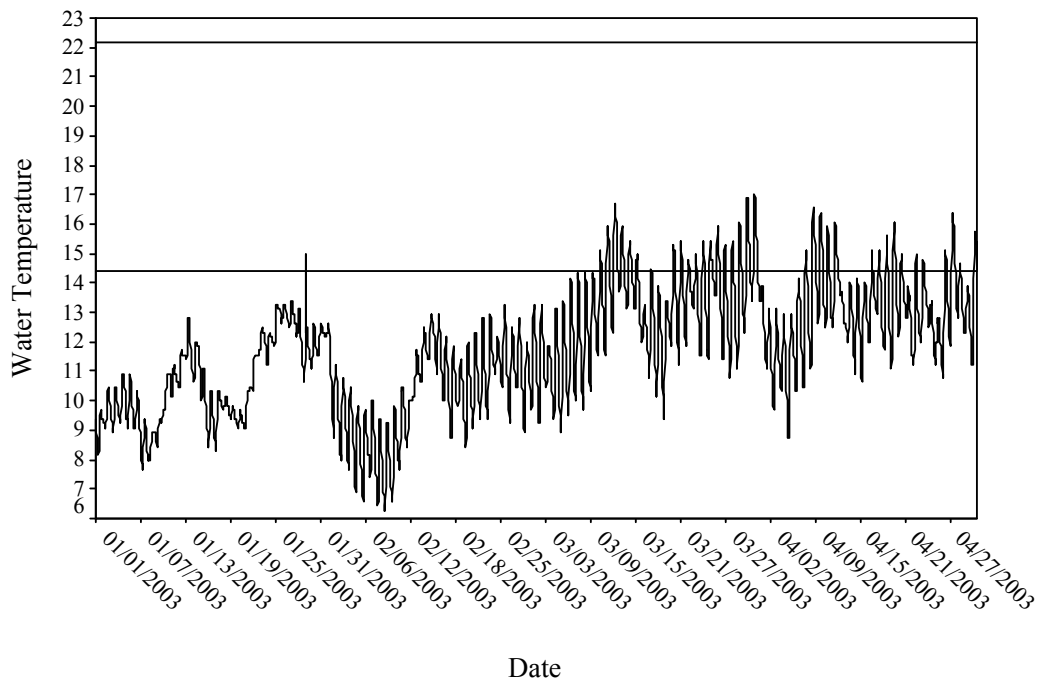


Figure 6. Water temperature time series for Doty Ravine at the Garcia property, May through August 5, 2003. Temperatures are suitable for juvenile rearing.

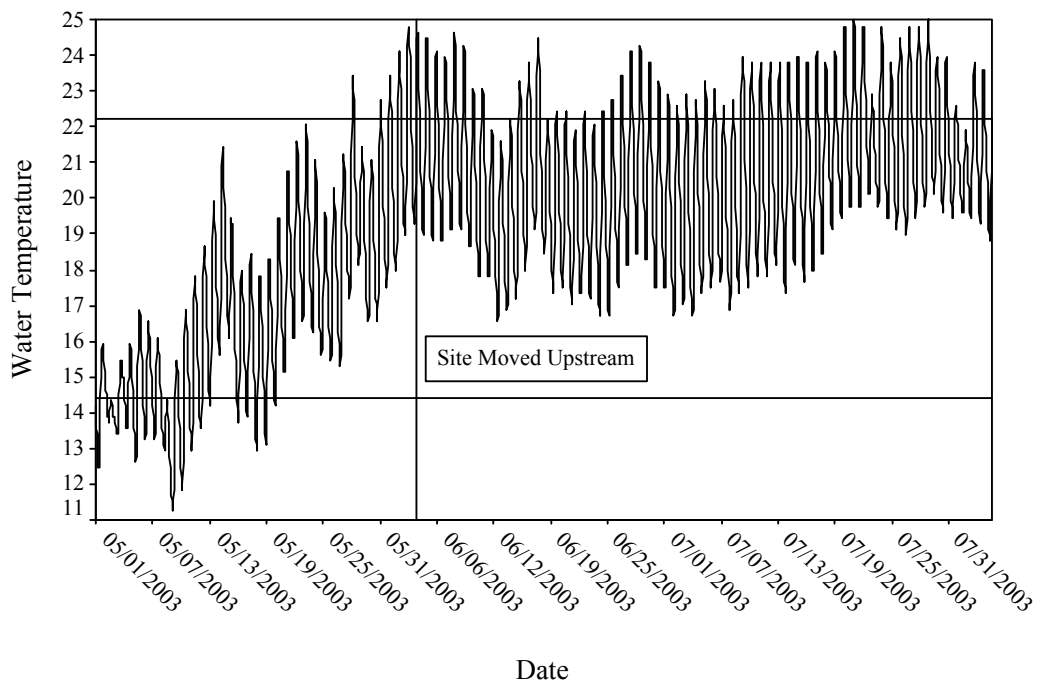


Figure 7. Water temperature time series for Doty Ravine at Wise Road, June 4 through August 5, 2003. Temperatures are suitable for juvenile rearing.

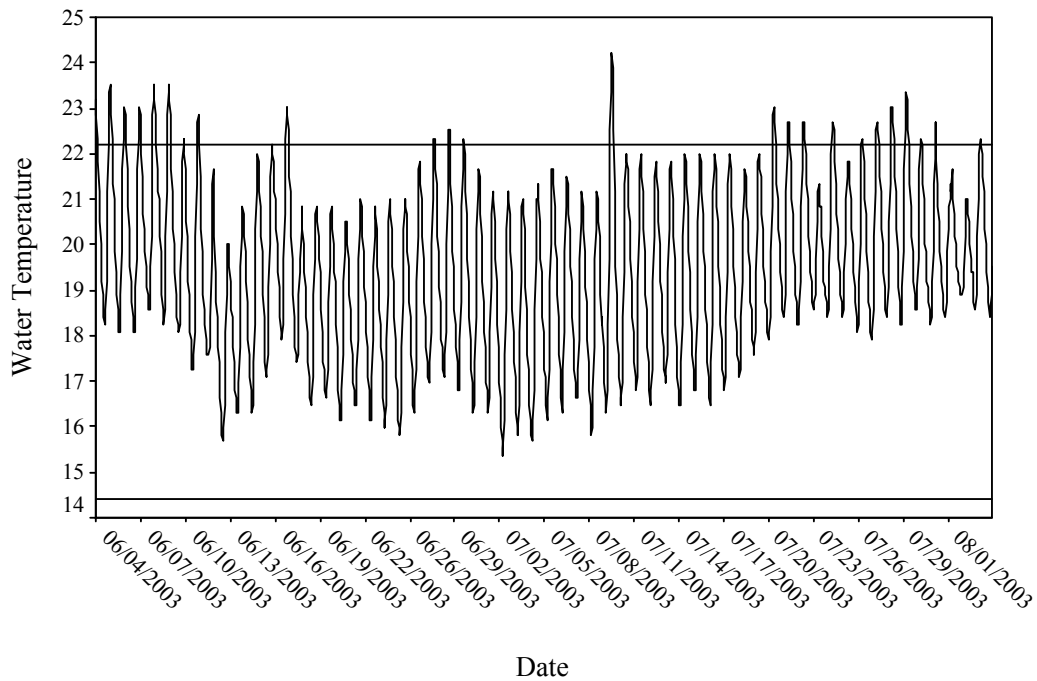
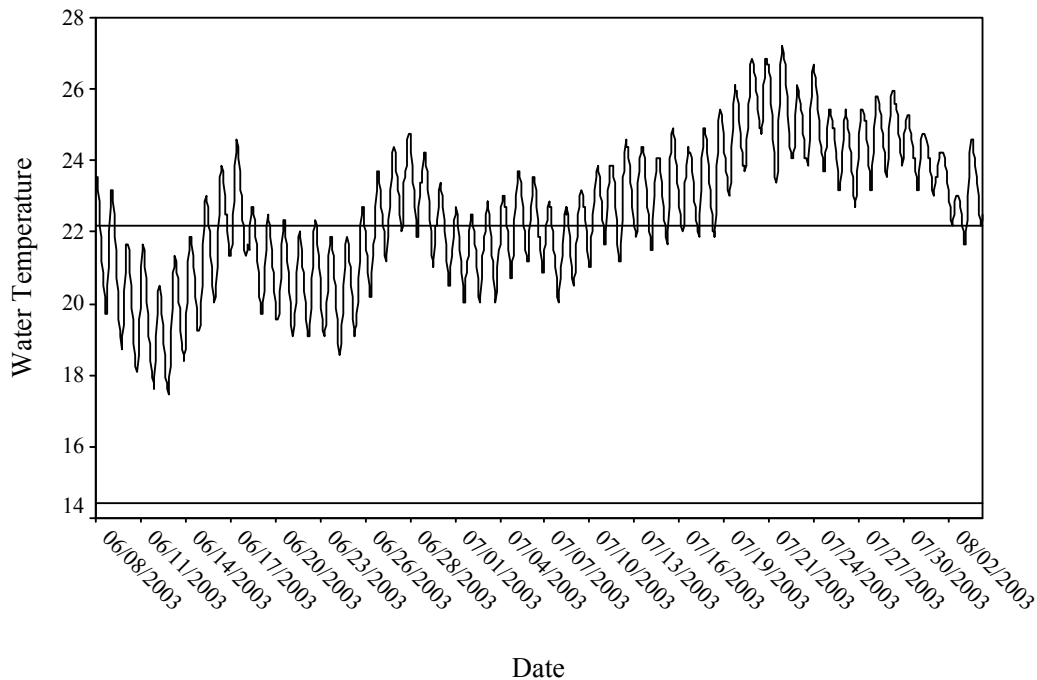


Figure 8. Water temperature time series for Doty Ravine at Goldhill Road, June 4 through August 5, 2003. Temperatures are marginally suitable for juvenile rearing.



C. Benthic Invertebrate Data

Limited benthic macroinvertebrate data (see Appendix Doty Ravine 1 for the complete data set) have been collected from Doty Ravine at the Garcia Property, just upstream of Crosby Herold Road. Samples were collected in December 2000, October 2001, and some unknown time in 2002 (Mark Fowler indicated that the 2002 samples have been collected, but analysis was not complete). The data are limited in usefulness for two reasons. First, samples were collected with equipment that does not readily collect all taxa present in the stream. Second, during the initial sorting, generally less than 100 individuals are selected for taxonomic identification. This limited sample size raises concerns regarding the representativeness of the data. However, the data do indicate that organisms that are moderately to highly tolerant of water quality impairment dominate the invertebrate community. A combination of flow fluctuations, water quality, and the amount of sediment in the stream channel probably contributes to this general lack of diversity and tendency towards species that are pollution tolerant. **Source: Benthic Macroinvertebrates sampled from Placer County Streams. Prepared for the Auburn Ravine Group by BioAssessment Services, Folsom, CA. December 2002.**

D. Physical Habitat Data

1. 1964 Chinook Salmon Spawning Gravel Survey [This information is not fully documented in CDFG files, and was based on an unsigned author note in CDFG, Region 2 files. I assume that this data is from Eric Gerstung's 1964 adult fall-run chinook salmon spawning surveys]. The following information was reported.

Section	Stream Miles	Distance Surveyed	Spawner Capacity/mi.	Salmon Use [Observed?]	Section Capacity
Coon Creek to McCourtney Rd.	4.0	--	50	0	1 mile w/ gravel = 50 fish
McCourtney Rd. to Fruitvale [Crosby Herold]	1.5	0.2	100	0	150
Fruitvale [Crosby Herold] to Garden Bar Rd.	1.0	0.3	100	0	100
Garden Bar Rd. to Wise Powerhouse Rd. [Wise Rd.]	1.0	--	50	0	50
Wise Powerhouse Rd. [Wise Rd.] to Goldhill Rd.	1.7	--	50	0	50

Source: Unsigned author note in CDFG, Region 2 files.

2. 2003 Placer County Spawning Gravel Survey: During the summer of 2003, Placer County funded a survey to examine steelhead trout spawning gravels in this drainage (as well as others). No data are currently available from this effort.

3. 2003 Placer County Stream Videography Project: On March 12, 2003 Doty Ravine was videotaped from the air from the confluence with Coon Creek upstream to a point above Wise Road. Review of the video footage shows that the riparian area of the stream varies from very poor quality to very high quality, depending on the location. Generally the degraded areas of riparian are in the downstream locations. Also, this footage revealed extensive bank erosion that is contributing to the sediment load in the stream. The proportion of the excessive sediment load attributable to bank erosion versus decomposition of underlying rock formations is unknown. Sediment contributions from land disturbing activities and roadways are also unknown. **Source: 2003 Placer County Stream Videography Project, unpublished data.**

E. Fishery Resource Data

1. Documented Fish Species Present in the Stream

Fall chinook salmon (native)
 Fall chinook salmon (introduced – Feather River Fish Hatchery)
 Spring-run chinook salmon (introduced – Feather River Fish Hatchery)
 Sacramento pikeminnow (formerly known as Sacramento squawfish)
 Sacramento sucker
 Brown trout
 Catfish (species undocumented)
 Rainbow trout/steelhead
 Tule perch

Source: California Department of Fish and Game, Region 2 files

2. Fish Stocking Records

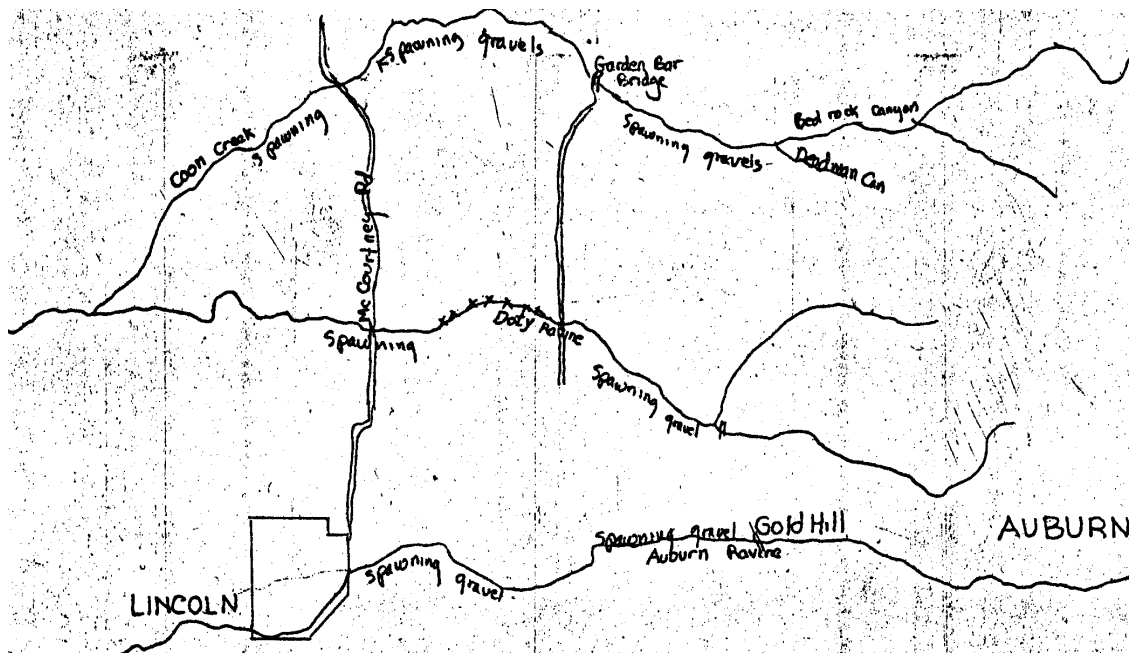
The following stocking records for chinook salmon were found in CDFG's Region 2 files:

Species	Origin	Date	Size (No./lb)	Mean Length*	Number Stocked	Location
Fall chinook salmon	Feather R. FH	1/27/87 or 1/28/87	704	42 mm	49,280	Garden Bar Road
Fall chinook salmon	Feather R. FH	1/31/86 or 2/3/86	480	48 mm	24,000	Garden Bar Road
Spring-run chinook salmon	Feather R. FH	2/20/85	344	54 mm	77,400	Gladding Road

*Length estimates from Fish Hatchery Management, Fish and Wildlife Service, 1992.

3. Adult Spawning Timing, Distribution, and Population Estimates

- **1964 Fall-run Chinook Salmon Spawning Survey by Eric Gerstung:** Gerstung noted that fish moved upstream after rains on October 30, 1964. Spawning was 80% complete by November 23, 1964. Fish and Game wardens reported that many fish had been poached before the survey started [this statement is probably not particularly relevant to Doty Ravine because of the low estimated adult spawning run of 10 fish]. Gerstung notes that the spawning runs were similar to 1963, but no data on the 1963 runs were found in the files examined. Gerstung surveyed 5,000 linear feet of stream, on November 23, 1964 near the Garden Bar Road Bridge [See figure below] and found 1 live fish and 1 carcass. Small x's indicate salmon spawning survey areas and other text indicates areas where spawning gravels were present. The water was reported clear, with flow estimated at 15 cfs. **Source: May 25, 1965 memorandum in CDFG, Region 2 files.**



- **December 6, 1985 Spawning Survey:** Three locations on Doty Ravine were surveyed for fall-run chinook salmon on 12/6/85. No specific locations were documented. No fish or redds were observed. Flow was estimated at 10 cfs. **Source: Unsigned, unidentifiable author note in CDFG, Region 2 files.**
- **Fall 1958 Anecdotal Report:** Unidentified rancher reported fall-run chinook salmon in Doty Ravine to an unknown Fish and Game employee in March of 1959. **Source: Unsigned, unidentifiable author note in CDFG, Region 2 files.**
- **Warden's Patrol Report:** Fish and Game Warden Wayne Caldwell reported seeing 37 [fall-run?] chinook salmon in Doty Ravine prior to November 10th of an unidentified year. **This observation is probably based on a 1979 warden's report, which has Warden Caldwell's signature.**

4. Juvenile Distribution and Sampling Data

- **March 3, 1959 Electrofishing Survey:** No specific location is reported. Unknown author reports small rainbow trout population. The following fish species were captured by electrofishing an unknown length of stream:
 2 rainbow trout (8-10 inches in length)
 “few” brown trout
 suckers (up to 24 inches in length)
 catfish

Source: Unsigned, unidentifiable author note in CDFG, Region 2 files.

- **Spring 1965 Fall-run Chinook Juvenile Emigration Survey by Eric Gerstung:** Gerstung began trapping downstream migrant fall-run chinook juveniles on 2/24/1965 and continued through 3/17/1965. Trap location is reported as T 13 N, R 6 E, S 34, NW1/4 of NE1/4; approximately 100 yards downstream of “Gladding Clay Pit Road” on the left bank [Review of the topographic map indicates that this site was located approximately 100 yards downstream of the Gladding Road crossing over Doty Ravine. Sampling was with a “riffle” trap or perforated plate trap, which covered 7ft of the 22ft. width of the channel. The trap fished a total of 503.5 hours and captured 2 juvenile chinook salmon. Water clarity was recorded as clear for each day [11 days] the traps were checked over this time period. Water temperatures were recorded at the time the traps were checked and are reported above, in the water temperature section of this report. Gerstung notes: “Most salmon are believed to have remained in the stream above the traps during the sampling period” [General statement regarding all of the streams surveyed}. No other fish species catch composition data is reported. **Source:** May 25, 1965 memorandum in CDFG, Region 2 files, handwritten draft of May 25, 1965 memo, and other handwritten notes.
- **1984 Seining and Electrofishing for Native Brood Year 1983 Fall-run Chinook Salmon:** Water temperatures for this sampling effort are reported above. The following sampling results are reported for this sampling effort. **Source:** Unsigned, unidentifiable author note in CDFG, Region 2 files.

Date	Effort	No. Chinook	Length Mode (mm)	Length Range (mm)	Other Fish Species	Location
2/28/84	2 seine hauls	4	40	40-44	1 – tule perch 3-squawfish*	McCourtney Road
2/28/84	2 seine hauls	4		35-44		Garden Bar Road
3/27/84	100-200' electrofish.	0				McCourtney Road
5/2/84	2 seine hauls	1		97	3-squawfish* 1 – sucker	McCourtney Road

* Sacramento squawfish are now known as Sacramento pikeminnow.

Source: Unsigned, unidentifiable author note in CDFG, Region 2 files.

F. Fish Passage or Screening Data

This section of the report documents known fish passage or screening needs. Immediately below are brief discussions of the two man structures that may be fish passage impediments or barriers under certain flows or operational conditions. Following these assessments is a discussion of water flows and beaver activities, which may preclude anadromous fish from reaching these two structures under adverse flow conditions.

1. Doty Ravine, NID Doty Ravine South Diversion Structure (Assessment by Randy Bailey, based on an on-site visit and discussions with NID staff)

This structure was not included in the evaluation of diversion structures during the completion of the Auburn Ravine/Coon Creek Ecosystem Restoration Plan

- **Location:** This structure is located on Doty Ravine approximately ¼ to ½ mile downstream of Crosby Herold Road.
- **General Description:** This diversion is a U-shaped concrete structure with abutments and sidewalls approximately 6 feet high with a concrete bottom. An inlet into a canal is situated on the south bank of the channel and consists of concrete headworks with a trash rack. The bottom of the structure is relatively flat with an approximately 6-foot apron downstream of the flashboard location. Downstream of the apron, a boulder field approximately 20-30 feet long has been placed to stop water from scouring underneath and undermining the concrete apron. Flashboards are installed at the beginning of the irrigation season (about April 15 in most years) and removed at the end of the season (about mid-October). During the irrigation season, little flow is allowed downstream of this point.
- **Assessment:** Given the general season of operation, under moderate to high flows, this diversion structure does not present a problem for adult anadromous fish migrating upstream to spawn. Under lower flows (unquantified at this time) the boulder field immediately downstream of the apron would become a passage barrier for adults. However, under lower flows, it may be impossible for adults to even reach this location from downstream because of lack of water depth or other passage impediments such as beaver dams. Also, the headworks for the canal are unscreened and juveniles could be diverted into the canal.

Since the water diversions at this site do not generally begin until mid-April it is possible that juveniles moving downstream of this location would be killed by high water temperatures in Coon Creek or the Eastside/Cross canals before they could reach the Sacramento River. However, insufficient water temperature monitoring data exists to reach a conclusion one way or another. In years of high runoff and/or a cool spring, it may be possible for juveniles to emigrate successfully. Also, during years of high late-spring runoff, the diversion would not be operated in mid-April. It is also important to note that actively emigrating smolts could easily transit the distance from this diversion

site to Coon Creek in as little as one day. Fall-run chinook salmon have been documented spawning upstream of this location.

2. **Doty Ravine, Garden Bar Road Culvert (adapted from the Auburn Ravine/Coon Creek Ecosystem Restoration Plan; analysis by James Buell, PhD)**

- **Location:** The Garden Bar Road crossing of Doty Ravine
- **General Description:** The Garden Bar Road crossing of Doty Ravine consists of a masonry and fill road prism extending across the stream channel with a 12 ft diameter round culvert. The culvert is sloped at about 2% and is perched about 4 ft above the low flow water surface of a large scour hole immediately downstream of the road fill. This scour hole is used as a “swimming hole” by local residents, and extends about 100 ft downstream to a gravel tail bar. The active stream channel is well over 100 ft wide downstream of the scour hole and is depositional in nature. Bed materials are primarily sand and fine gravel, with gravel and cobbles in the thalweg. Banks are composed of fine materials and are erodible.
- **Assessment:** The perched nature of the culvert and its slope combine to make this crossing an effective adult anadromous fish migration barrier at all but flows high enough to backwater the culvert invert. The very wide control of the scour hole downstream indicates that backwatering would only be achieved under very high stream flows. Given the length and slope of the culvert, it is possible that some aggressive steelhead could negotiate this crossing under less-than-backwatering stream flows, but it is likely that most fish would not.
- **Priority for Attention:** High.
- **Alternative approaches:** Several alternatives are available for achieving good fish passage conditions under most stream flows at the Garden Bar Road crossing of Doty Ravine:
 - (a) ***Culvert replacement with a bridge.*** This approach would involve removing most or all of the masonry and fill road prism across the Doty Ravine stream corridor and replacing it with a formal bridge structure. Advantages of this approach are good passage conditions under virtually all stream flows during which adult anadromous fish are migrating with little or no maintenance other than standard bridge maintenance. Disadvantages include very high cost and eventual disappearance of the “swimming hole.”
 - (b) ***Culvert replacement with an arch culvert.*** This approach is similar to the first alternative, except it would require less demolition of the existing road prism. The arch should be large enough to convey flood flows without foundation scour. A “natural” streambed bottom would be maintained, perhaps with some scour to large pavement materials (large cobbles, boulders), and concrete footings would be required to prevent

undermining. Advantages of this approach include good passage conditions under the great majority of stream flows during which adult anadromous fish are migrating, with little or no maintenance other than standard arch culvert maintenance. Disadvantages include high cost and eventual disappearance of the “swimming hole”.

(c) ***Culvert replacement with a larger elliptical culvert.*** This approach is similar to the second alternative, except it would not require concrete footings (although the culvert would still have to be sealed). Culvert size should be established through an engineering analysis, but would probably be about 16 ft on the vertical axis. The invert of the culvert should be submerged for its entire length under low flow conditions. Advantages of this approach include elimination of bed scour under the road crossing and good passage conditions under the great majority of stream flows during which adult anadromous fish are migrating with little or no maintenance other than standard culvert maintenance. Disadvantages include high cost and probably eventual reduction in size of the “swimming hole”.

(d) ***Backwater culvert with a series of box weirs.*** This approach would involve construction of a series of low box weirs extending downstream from the mouth of the culvert. Dimensions of the series should be established by an engineering analysis, but the entire footprint may be on the order of 30 ft wide by 50 ft long (downstream direction). Each box weir should have three rectangular notches (approximately 24 in wide x 10 in deep) to concentrate flow at moderate stream discharge, one on each side and one in the downstream end. Notches should be staggered rather than aligned. The elevation of the invert of the notches upstream-most box weir should not be more than 1 ft below the elevation of the invert of the existing culvert. It is likely that three box weirs will be required, but it is possible that two will be sufficient. Advantages of this approach include good passage conditions under most stream flows during which adult anadromous fish are migrating with little or no maintenance and relatively modest cost. Disadvantages include potential reduction of conveyance capacity of the existing culvert and significant encroachment into the existing “swimming hole.”

(e) ***Construct Alternative 4 using gabions.*** This approach is essentially identical to Alternative 4 except that gabions (rock-filled wire baskets) would be used to construct the box weirs. Advantages include those associated with Alternative 4 and lower cost. Disadvantages include periodic maintenance and repair and safety risk associated with sharp broken wires in an area actively used by children for water-oriented recreation.

(f) ***Backwater culvert with a series of low “V” weirs.*** This approach would involve construction of a series of low, shallow-angle “V” weirs across the entire Doty Ravine stream corridor and reinforcing (armoring) stream banks in the vicinity of each weir (possibly the entire project area). The angle of the “V” in each weir should be sufficient to concentrate flows near the center of the channel; however the series should be staggered off the channel centerline by about 8-10 ft. The elevation of the invert (center of the “V”) of the upstream-most weir should be not more than 1 ft below the elevation of the invert of the culvert. It is likely that three weirs would be required. Advantages of this approach include good passage conditions under most flows during which adult

anadromous fish are migrating with little or no maintenance and probably insignificant reduction in conveyance capacity of the existing culvert (an engineering analysis of this parameter should be performed, however). Disadvantages include significantly higher cost than the fourth alternative (see above), potential bank scour and very extensive “modification” of the “swimming hole”.

- **Recommendation:** Perform hydraulic and cost analyses on the third and fourth alternatives, above (culvert replacement with elliptical culvert, submerged invert; series of notched box weirs). Select and implement the most cost-effective approach meeting appropriate engineering and conveyance criteria.

3. Water Flows

Fall and winter water flows are particularly important in Doty Ravine. Because water deliveries are curtailed, generally before fall-run chinook salmon attempt to migrate upstream to spawn, the depth of water in the channel can be insufficient to provide adult passage. Adult chinook salmon and steelhead need approximately $1\pm$ foot of water depth with some resting pools in order to migrate upstream. Transit time for adult fish from the Coon Creek confluence to upstream of Crosby Herold Road could routinely be accomplished in one day. However, adequate water depth is critical and should be taken into consideration concurrently with any fish passage projects for this drainage.

4. Beaver Dams

Beaver dams and beaver activity in general hinder adult anadromous fish passage in this watershed. During the stream videography project, six major beaver dams were documented from the air, between the confluence with Coon Creek and an area upstream of the Wise Road crossing on March 12, 2003. During the fall/winter of 2002/2003, major beaver dams were located within 100 feet of the Crosby Herold and Wise Road crossings. These dams remained in place and blocked adult fish passage for the entire spawning season for both fall-run chinook salmon and steelhead, with the possible exception of part of one day at the Crosby Herold Bridge. There may have been other passage problems related to beaver activity further downstream that would render the problems at upstream locations moot.

APPENDIX DOTY RAVINE 1

BENTHIC MACROINVERTEBRATE DATA COLLECTED BY THE AUBURN RAVINE CITIZENS GROUP

PHYLUM						12/01/00			10/01/01					
	Class					Doty Ravine @			Doty Ravine @					
		Order					Garcia			Garcia				
			Family				A	B	C	A	B	C		
				<i>Genus species</i>	TV ¹	FFG ²								
ARTHROPODA														
	Hexapoda													
		Coleoptera (Larvae)												
			Elmidae		5	cg				1				
			Psephenidae		4	sc								
		Diptera												
			Chironomidae		6	cg	4	1	4	30	19	17		
			Empididae		6	p	4	3		3				
			Simuliidae		6	cf	1	6	2	1	5	2		
			Tipulidae		3	sh								
		Ephemeroptera												
			Baetidae		4	cg	9	19	14	12	28	24		
			Ephemerellidae		1	cg	1							
			Leptohyphidae		4	cg	19	14	29	5	5	11		
		Plecoptera												
			Capniidae		1	sh		2	1					
			Chloroperlidae		1	p	2	7						
			Perlodidae		2	p	5	9	3	1		2		
		Trichoptera												
			Brachycentridae		1	ot				1				
			Glossosomatidae		0	sc	3	4	4		1	1		
			Hydropsychidae		4	cf	22	17	17		2			
			Hydroptilidae		4	ot				3	6	1		
			Leptoceridae		4	ot								
			Philopotamidae		3	cf					1	1		
		Lepidostoma												
			Pyralidae		5	sc	2							
		Odonata												
			Coenagrionidae		9	p								
			Gomphidae		4	p	2	5	3	3	5	3		
			Libellulidae		9	p	2	3	7	1	3			
Subphylum Chelicerata														
	Arachnoidea													
		Hydracarina (=Acari)			5	p	1	1		3		2		
Subphylum Crustacea														
	Malacostraca													
		Amphipoda			4	cg	4	1	6	3	2	2		

MOLLUSCA										
	Gastropoda									
		Limnophila								
			Planorbidae	6	sc				3	3
	Bivalvia									
		Pelecypoda								
			Corbiculacea	10	cf				3	2
NEMATODA				5	p		1		2	1
NEMERTEA						11	5		4	2
PLATYHELMINTHES										
	Turbellaria									
		Tricladida								
			Planariidae	4	p					
ANNELIDA										
	Oligochaeta			5	cg	1	6	4	10	15
					Total Macroinvertebrates:	93	104	94	86	99
¹ TV: Tolerance Values										
² FFG: Fuctional Feeding Groups										
					Taxonomic Richness	17	17	12	17	15
					EPT Taxa	7	7	6	5	6
					Ephemeroptera Taxa	3	2	2	2	2
					Plecoptera Taxa	2	3	2	1	0
					Trichoptera Taxa	2	2	2	2	4
					EPT Index	66	69	72	26	43
					Sensitive EPT Index	12	21	9	2	2
					Tolerance Value	3.5	3.6	4.3	4.9	5.0
					Percent Intolerant Organisms	12	21	9	2	2
					Percent Tolerant Organisms	2.2	2.9	7.4	1.2	6.1
					Percent Dominant Taxon	24	18	31	35	28
					Percent Collectors	41	39	61	71	70
					Percent Filterers	25	22	20	1	11
					Percent Grazers	5	4	4	3	4
					Percent Predators	17	28	14	15	9
					Percent Shredders	0	2	1	0	0
					Other	0	0	0	5	6

PHYLUM							12/01/00			10/01/01		
	Class						Doty Ravine @			Doty Ravine @		
		Order					Garcia			Garcia		
			Family			Site Code:	A	B	C	A	B	C
					TV ¹	FFG ²						
ARTHROPODA												
	Hexapoda											
		Coleoptera (Larvae)										
			Elmidae		5	cg				1		
			Psephenidae		4	sc						
		Diptera										
			Chironomidae		6	cg	4	1	4	30	19	17
			Empididae		6	p	4	3		3		
			Simuliidae		6	cf	1	6	2	1	5	2
			Tipulidae		3	sh						
		Ephemeroptera										
			Baetidae		4	cg	9	19	14	12	28	24
			Ephemerellidae		1	cg	1					
			Leptohyphidae		4	cg	19	14	29	5	5	11
		Plecoptera										
			Capniidae		1	sh		2	1			
			Chloroperlidae		1	p	2	7				
			Perlodidae		2	p	5	9	3	1		2
		Trichoptera										
			Brachycentridae		1	ot				1		
			Glossosomatidae		0	sc	3	4	4		1	1
			Hydropsychidae		4	cf	22	17	17		2	
			Hydroptilidae		4	ot				3	6	1
			Leptoceridae		4	ot						
			Philopotamidae		3	cf					1	1
		Lepidostoma										
			Pyralidae		5	sc	2					
		Odonata										
			Coenagrionidae		9	p						
			Gomphidae		4	p	2	5	3	3	5	3
			Libellulidae		9	p	2	3	7	1	3	
Subphylum Chelicerata												
	Arachnoidea											
		Hydracarina (=Acari)			5	p	1	1		3		2
Subphylum Crustacea												
	Malacostraca											

		Amphipoda	4	cg	4	1	6	3	2	2
MOLLUSCA										
		Gastropoda								
		Limnophila								
		Planorbidae	6	sc				3	3	
		Bivalvia								
		Pelecypoda								
		Corbiculacea	10	cf					3	2
NEMATODA			5	p		1		2	1	1
NEMERTEA					11	5		4		2
PLATYHELMINTHES										
		Turbellaria								
		Tricladida								
		Planariidae	4	p						
ANNELIDA										
		Oligochaeta	5	cg	1	6	4	10	15	17
					Total	93	104	94	86	99
¹ TV: Tolerance Values										
² FFG: Functional Feeding Groups										

	12/01/00			10/01/01		
	Doty Ravine @			Doty Ravine @		
	Garcia			Garcia		
	Mean	SE	CST	Mean	SE	CST
Taxonomic Richness	15	1.7	19	16	0.7	21
EPT Taxa	7	0.3	8	6	0.3	8
Ephemeroptera Taxa	2	0.3	3	2	0.0	2
Plecoptera Taxa	2	0.3	3	1	0.3	1
Trichoptera Taxa	2	0.0	2	3	0.6	5
EPT Index (%)	69	2.0	69	38	6.3	38
Sensitive EPT Index (%)	14	3.8	14	3	0.8	3
Dominant Taxon (%)	24	3.6	21	30	2.4	24
Tolerance Value	3.8	0.2	3.8	4.8	0.1	4.8
Intolerant Organisms (%)	14	3.8	14	3	0.8	3
Tolerant Organisms (%)	4.2	1.7	4.1	3.2	1.5	3.3
Collectors (%)	47	6.8	47	74	3.5	74
Filterers (%)	22	1.3	22	6	2.9	6
Grazers (%)	4	0.5	4	3	0.9	3
Predators (%)	20	4.2	20	11	2.0	11
Shredders (%)	1	0.6	1	0	0.0	0
Other (%)	0	0.0	0	4	1.5	4
* Site statistics based on small and variable sample sizes						

	12/01/00			10/01/01		
	Doty Ravine @			Doty Ravine @		
	Garcia			Garcia		
	DRG-A	DRG-B	DRG-C	DRG-A	DRG-B	DRG-C
Taxonomic Richness	17	17	12	17	15	15
EPT Taxa	7	7	6	5	6	6
Ephemeroptera Taxa	3	2	2	2	2	2
Plecoptera Taxa	2	3	2	1	0	1
Trichoptera Taxa	2	2	2	2	4	3
EPT Index (%)	66	69	72	26	43	45
Sensitive EPT Index (%)	12	21	9	2	2	5
Dominant Taxon (%)	24	18	31	35	28	27
Tolerance Value	3.5	3.6	4.3	4.9	5.0	4.6
Intolerant Organisms (%)	12	21	9	2	2	5
Tolerant Organisms (%)	2.2	2.9	7.4	1.2	6.1	2.3
Collectors (%)	41	39	61	71	70	81
Filterers (%)	25	22	20	1	11	6
Grazers (%)	5	4	4	3	4	1
Predators (%)	17	28	14	15	9	9
Shredders (%)	0	2	1	0	0	0
Other (%)	0	0	0	5	6	1
* Sample size less than 50 organisms						